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Municipal Engineering

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SOME NOTES ON ELECTRIC LIGHT AND POWER DISTRIBUTION.

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WIRING SYSTEMS.

In connecting up constant potential machines, one wire is connected to the positive and one to the negative pole of the machine. If two machines are operated together, the positive side of one and the negative side of the other can be connected to a common wire called the "neutral wire," the remaining positive and negative sides of the machines having each its individual wire. This is known as the "three-wire system." In this case the voltage between the outside wires is double the generator voltage, as the generators work in series, and the size of the outer wires should be calculated on that basis. The neutral wire in the feeder distribution should, in most cases, have about one-third of the section of the outer wires; while in the mains and for house wiring in general, the neutral wire is usually made of the same size as the other conductors.

In the two-wire alternating system, the two wires are of equal size and calculated in accordance with the formulas already given. Where a three-wire secondary system is used from the transformers, the secondary wiring should be calculated from the voltage of the outside wires, and the three wires made uniform in size.

The three wires of the three-phase system should be made equal.

It should be remembered that in all three-wire constant current systems, and in all two-phase and three-phase alternating systems, it is necesary to keep the load quite evenly divided between the different sides or "legs" of the system, in order to obtain satisfactory regulation. This point has not to be borne in mind, either in the ordinary two-wire constant current system, or in the single-phase and monocyclic alternating systems.

In electrical distribution one of two cases has usually to be considered.

1. Either the current is to be transmitted to a definite location for consumption at the end of the transmission system.

2. Or it is to be distributed over a territory for more or less general use.

At a uniform voltage and a given loss, the various systems are found to require copper for minimum difference of potential, as follows: (See Oudin "Standard Polyphase Apparatus and Systems.")

TABLE X.

	Number of wire.	Per cent. copper.
Direct current	2	100
Direct current neutral one-third section	3	28.1
Direct current neutral full section	3	37.5
Single-phase	2	100
Single-phase	3	37.5
Two-phase common return	3	72.9
Two-phase	4	100
Three-phase	3	75
Three-phase neutral full section	4	33.3
Three-phase neutral one-half section	4	29.2

The above would indicate that high potential direct current machinery is the most economical for long distance transmission. The difficulty, however, of generating and utilizing direct currents of high voltage is so great that alternating currents are now almost exclusively used for that purpose. In a majority of cases the current is generated at a moderate voltage and transformed to a high voltage for transmission, and at the point where it is to be used it is again transformed to a moderate voltage for local distribution and use.

EFFICIENCY OF DEVICES FOR UTILIZING THE ELECTRIC CURRENT.

From what has preceded, it will be seen that the wire loss can be controlled by the size of wire, and can be reduced as low as found practicable, or, broadly stated, the greatest economy is obtained when the annual cost of the energy loss equals the interest on the wire investment.

Table XI, following, gives the efficiency of various sized generators and motors of first-class construction and various types.

In alternating systems, where advantage is taken of transmitting the current at high potentials, the current has to be transformed from one voltage to a higher or lower, as required for transmission or use. As in all other energy transformers of good design, working at full load, these losses are often only two or three per cent., but in small transformers of poor design the loss is frequently very great, amounting in some cases to more than 40 per cent. of the total energy received by the primary coils of the transformer during a twenty-four hour run.

TABLE XI.

TABLE SHOWING EFFICIENCY OF VARIOUS SIZED GENERATORS AND MOTORS OF FIRST-CLASS CONSTRUCTION.

Type of Machine.	Power K. W.	LOAD. Full.	¾	½	¼	Temperature Rises.
Constant Current Generator.	40	85	82	76.5	73	Tem. armature 50°, fields 70°, 10 hr. run.
	50	86	83	77.5	74	
	60	87	84	78.5	75	
	75	87	84	78.5	75	
Constant Potential Belted Generator.	20	88.5	87	84	76	Tem. 45° C., any part of machine. 10 hr. run.
	40	90	89	87	80	
	65	91	90	87	81	
	85	92	90.3	87	81	
Constant Potential Direct Con. Generator.	25	89	89	87	81	Tem. armature and fields 45°, commutator 55°. 24 hr. run.
	35	90.5	90	89	83	
	50	91	91	89.5	84	
	100	92	92	91	86	
Alternating Single Phase 125 Cycle Generator.	30	90	88	85	76	Temperature 45° C. any part mach. 24 hr. run.
	60	91	90	87	78	
	90	91	90	87	78	
	120	92	91	88	80	
60 Cycle Generator.	60	90	89	86	78	
	90	91	90	87	79	
	120	92	91	88	80	
Monocycle and 3 Phase Generator.	50	89	87.5	84	74	
	75	91	89	86.5	76.5	
	100	91	89	86.5	76.5	
Multi-Polar Direct Current Motors.	7	87	85	82.5		Temperature rise 45° C. armature and fields. 50° C., commutator. 10. hr. run.
	10	88	86	84		
	15	88	86.5	84		
	20	88	87	87		
	35	90	89	88		
	50	91	90	88.5		
	60	91	90	90		
	85		90			

TWO RIVERS, SIBLEY PARK, MANKATO, MINN.

Blue Earth River.

Minnesota River.

In lighting systems care should be taken to select good transformers of as large a capacity as practicable, and operate them as near full load as possible.

The following transformer efficiencies were recently guaranteed by a leading electrical company:

TABLE XII.

TRANSFORMER EFFICIENCIES.

Number of incandescent lights.	Full load.	Half load.	Quarter load.
40	95.2	94	90.3
60	96.2	95.5	92.7
80	96.4	95.9	93.6
100	96.6	96.2	94.2
150	96.7	96.2	94
200	96.9	96.4	94.3

The loss of transformers increases with age, hence the efficiency of such a system will decrease with time. This fact must be considered in estimating the value of a given system of transmission or distribution.

LAMPS.

The ordinary constant current open arc lamps are wound for an average of 45 volts. Unevenness in the carbons will, however, effect in these lamps a variation of from 43 to 47 volts. In the constant current or arc machine, arrangements are made for an automatic increase or decrease of voltage to take care of such variation in resistance. In constant potential circuits, however, no such change in voltage is possible: hence, a certain surplus voltage must be held in reserve to assist the lamps over any periods of extra resistance, in order to have them work satisfactorily. On 110 volt constant current circuits, two such lamps may be operated in series requiring 86 to 100 volts to operate them; the 10 volts remaining may be taken out in the wire resistance of the circuit or by a special resistance coil.

In 220-volt circuits, four such lamps can be operated in series, and the surplus voltage may be lost in wire resistance and in a special adjustable series resistance usually furnished with the lamps. In a three-wire 220-volt system with 440 volts between the outer wires, wire arcs can be run in series with a saving of 12½ per cent. over the 110 or 220-volt systems previously mentioned.

In any case, on constant potential systems, the combined lamp voltage and wire resistance must not approach too near the constant voltage of the machine, or the lamps will rob each other, and one or more will burn dimly while others receive the necessary voltage, this leading to unsatisfactory street lighting.

The enclosed arc lamp possesses many features which make it desirable for indoor illumination and for park and boulevard use. Its light is soft, subdued, and lacks the glare of the open arc, but this gain in quality is accompanied by a corresponding loss in efficiency. Its cost in watts per candle power is greater than the open arc.

The incandescent lamp is still less efficient than the enclosed arc. It is, however, the only successful means for the subdivision into small lighting units of the electric current. Incandescent lamps of various efficiencies are on the market, but the most efficient lamp can only be used where the variation in voltage in the distribution is closely controlled. Commercially, 16 candle power lamps are furnished, as follows:

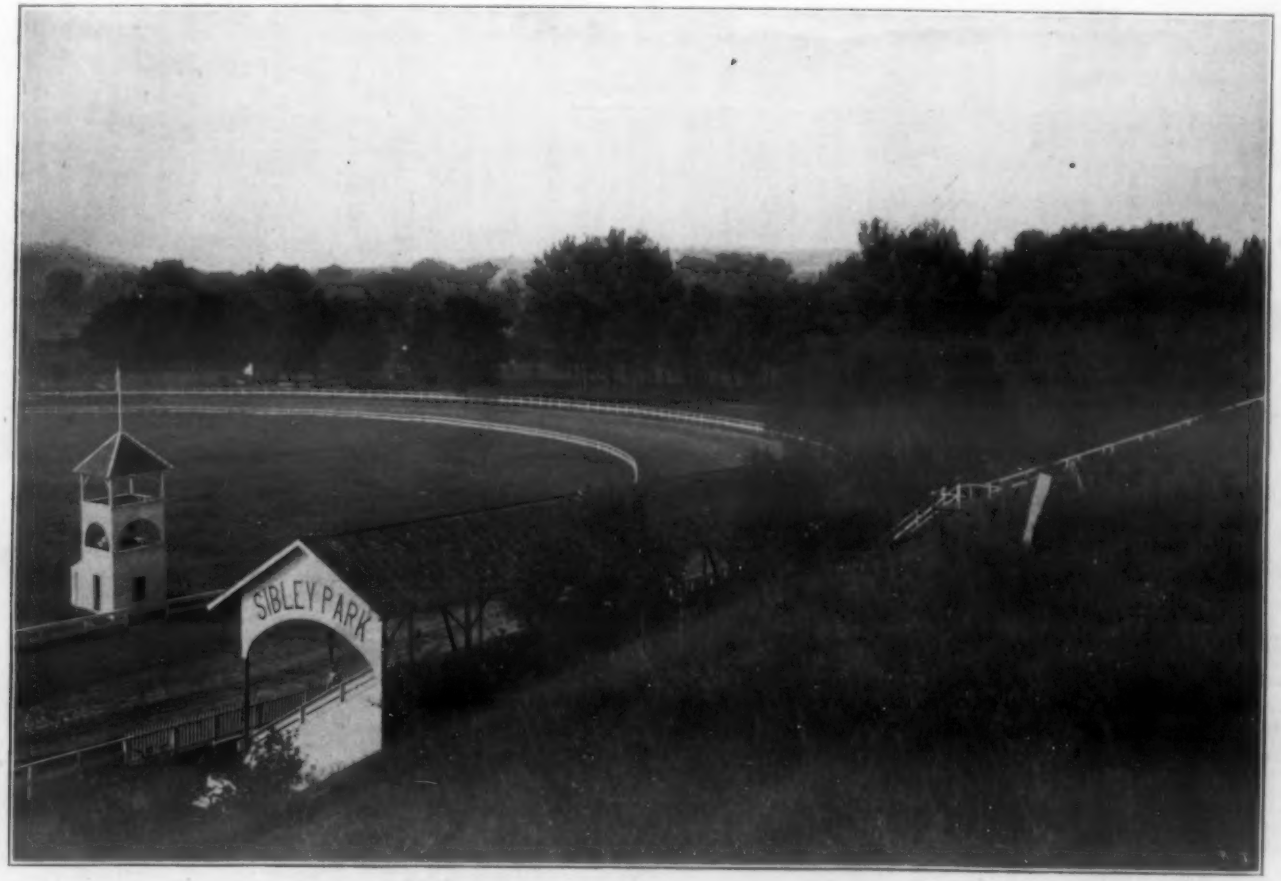
TABLE XIII.

Efficiency.	Watts Consumed.	Amperes in 110 Volt Distribution.	Amperes in 220 Volt Distribution
4 watt	64	.582	.291
3.6 "	57.6	.524	.262
3.1 "	49.6	.451	

The following table gives a general view of lamp efficiencies:

TABLE XIV.

Candle Power.		Kind of lamp.	Current.	Amperes.	Energy Factors.		
Rated.	Actual.				Volts.	Watts.	Watts for actual candle power.
2000	346	Open arc.	Constant current.	9.6	45	442	1.22
2000	346	Open arc.	Constant voltage.	10	55	550	1.59
2000	346	Open arc.	Constant voltage.	10	50	500	1.49
1200	208	Enclosed arc.	Constant voltage.	6	110	660	3.18
1200	208	Enclosed arc.	Constant voltage.	3	220	660	3.18
16	16	Incandescent.	Constant voltage.	.45	110	49.5	3.1
16	16	Incandescent.	Constant voltage.	.52	110	57	3.6
16	16	Incandescent.	Constant voltage.	.26	220	58	3.6
				.58	110	64	4.
				.29	220	64	4.



RACE TRACK, SIBLEY PARK, MANKATO, MINN.

THE EFFICIENCY OF TRANSMISSION SYSTEMS.

The efficiency of the various devices used in our electric transmission systems has already been briefly considered. Table XV, page 213, shows the equivalent values of various energy units if transformation was perfect.

All systems for the transformation or transmission of energy in any form are subject to losses, which should, however, be kept as small as possible. The various machinery and mechanisms used in connection with electric systems have ordinary efficiencies, as shown in Table XVI.

TABLE XVI.

ORDINARY EFFICIENCY OF MACHINERY USED IN CONNECTION WITH ELECTRIC PLANTS. SEE ALSO TABLES XI, XII AND XIV.

CLASS OF MACHINERY.		Efficiency per cent. at full load. Maximum.	Minimum.
Water-Wheels.	Over shot wheels	75	65
	Breast wheels	65	60
	Under shot wheels	40	25
	Turbines	85	60
	Impulse wheels	85	75
Steam Generator.	Boilers	75	50
	Steam pipe	95	75
Steam Engines.	*Condensing.*		
	Triple expansion Corliss	18	15
	Compound Corliss	15	12
	Simple Corliss	12	10
	Compound high speed	12	10
	Non-Condensing.		
	Compound Corliss	12	10
	Simple Corliss	9	7
	Compound high speed	9	7
	Simple high speed	7	6
	Simple slide valve	7	5
Heat Engines.	Gas or oil engines	20	16
	Diesel motor	30	25
Steam Air Compressor.	Compound condensing Corliss	12	10
	Simple con. Corliss	9	7
	Simple Corliss	6	5
	High pressure	4.5	3
	Small straight line	3	2
Air Motor	Air, cold	50	30
	Air, reheated	70	60
Transmitting Mechanisms.	Belt	95	85
	Rope	97	90
	Cable	95	75
	Direct connection	99	95
	Shafting	95	70
	Gearing	85	50
	Bevel gearing	75	50
Transmission Methods.	Pneumatic, per mile	97	92
	Hydraulic, per mile	98	90
	Electric, usual	95	85
	Power Pumps.		
Reciprocating pumps		80	60
Centrifugal pumps		80	50
Rotary pumps		80	50
Displacement air pump, free exhaust		23	20
Harris air pump exhaust to compressor		70	60
Air lift pump		40	15

For most uses of electrical energy, the best measurement of energy is the kilowatt hour, and the theoretical equivalence of various sources of energy expressed in this unit is given in Table XVII.

TABLE XVII.

APPROXIMATE THEORETICAL UNITS IN ONE KILOWATT-HOUR.

Foot pounds	2,654,150
Foot gallons	318,480
Thermal units	3,410
Horse-power hour	1.34
Pounds of steam (from and at 212°)	3.42
Pounds of hard coal	.23
Pounds of soft coal	.27
Gallons of gasoline	.032
Cubic feet of natural gas	3.72
" " " coal gas	5.95
" " " water gas	13.45
" " " producer gas	30.7

By the use of this table, together with the preceding efficiency tables, may be solved many of the problems concerning the selection of machinery for an electric system, and the size and kind of machinery best fitted for the work: For example, to compare soft coal at $2 per ton, natural gas at 15 cents per thousand feet, and gasoline at 5 cents per gallon for operating an electric lighting system.

For the use of coal will be required:

For Machinery	Efficiency of machine.	Net combined efficiency.	Necessary capacity to generate 1 K. W. at terminals. K. W.	H. P.
Steam boiler	70	70	3.00	4.01
Steam pipe	98	68.6	.....	.....
Simple high speed engine	6	4.12	2.28	3.04
Direct connection to dynamo	99	4.06	1.18	1.57
Dynamo average ½ load	88	3.57	1.05	1.45
Wiring system	95	3.39	1.00	1.34

TABLE XV.

EQUIVALENT UNITS OF POWER.

ELECTRICITY.	WORK.		HEAT.	WATER POWER.	
Watts.	Foot-Pounds Per Minute.	Horse-Power.	Thermal Units per Minute B. T. U.	Gallon Feet per Minute.	Cubic Feet Feet Head per Minute.
1.	44.25	.00134	.0568	5.308	.709
.0226	1.	.0000303	.001285	.12	.016
746.	33000.	1.	42.406	3960.	528.
17.58	778.	.02357	1.	93.45	12.44
.188	8.34	.00025	.0106	1.	.1337
1.41	62.48	.00189	.0851	7.49	1.

Table XVI shows it will take theoretically .27 lbs. of coal to equal a kilowatt hour, with a net combined efficiency in the system of 3.39%. The amount of coal needed will be $\frac{100}{3.39} \times .27 = 8.$ lbs., which at $2.00 per ton = .8 cents per kilowatt hour for fuel.

For the use of gas, or gasoline, there will be required :

For Machinery	Estimated efficiency.	Net combined efficiency.	Necessary capacity to generate K. W. at terminals.	
			K. W.	H. P.
Heat engine.....	18	18.	1.23	1.65
Belted to dynamo.	95	17.1	1.177	1.57
Dynamo.....	88	15.1	1.05	1.41
Wiring	95	14.3	1.00	1.34

From Table XVI, 3.72 cubic feet of natural gas should generate one theoretical kilowatt hour. With 14.3% efficiency it will take $\frac{100}{14.3} \times 3.72 = 26$ cubic feet.

26 cubic feet at 15 cents per thousand cubic ft. = .39 cents.

Again from Table XVI, .032 gallons of gasoline will develop a theoretical K. W. H. For an actual K. W. H., it will take $\frac{100}{14.3} \times .032 = .223$. This at 5 cents per gallon equals 1.115 cents. Hence the cost per actual K. W. hour will be :

For coal at $2 per ton..... .8 cents
For gas at 15 cents per 1,000 cubic ft..... .39 cents
For gasoline at 5 cents per gal.. 1.11 "

With coal at $2 per ton, natural gas would equal it in cost at 31 cents per thousand cubic feet, while gasoline would have to sell at 3.6 cents per gallon to admit of its use at an equal cost.

If the question arises as to the cost of fuel for a 2,000 c. p. constant current arc light per hour, it will be seen from Table XIV that each arc will take 550 watts; hence it will cost:

.8×550=.44 cents with coal,
.39×550=.214 " " gas, and
1.11×550=.611 " " gasoline,

for each lamp hour.

For machinery of other efficiencies, the results will be correspondingly different.

It will also be noted that on account of the various losses, the machinery used in the system must be proportionately larger.

One kilowatt equals 1.34 horse power, but

the steam engine must have a capacity of 3-horse power to obtain 1.34 kilowatt at the wire terminals, and the size of each other feature of the system in both kilowatt and horse power is set opposite to it in the table.

It must not be understood that the selection of a plant depends simply on the cost of fuel. This is an important item, but must also be considered together with other items. A comparative financial statement should include for each plant the following items:

Cost of operation:

Labor	$.....	
Fuel	.....	
Oil	.....	
Waste	.....	
Miscellaneous	.....	
		$.....
Interest on investment	.....	
Annual cost of maintenance	.....	
Annual deterioration of plant	.....	
Total relative cost of plant		$.....

Besides the financial relations, the questions of simplicity, reliability, etc., are often quite as important.

The question of the selection of machinery for economy is not always a simple one, for the maximum or full-load efficiency can not be expected in ordinary running, except in the rare cases where transmissions are designed for uniform conditions. In general, a station must be designed to carry a maximum load which is seldom or never reached, and, in the main, runs at only partial load and at much less efficiency. A careful study of the probable load curve and the probable average load to be carried should be made, and the generator efficiencies at various loads should also be carefully studied in the light of such estimates.

The following is an estimate of the probable load to be carried by an incandescent lighting circuit for each 1,000 lamps installed on meters.

TABLE XVIII.

ESTIMATE OF DISTRIBUTION AND USE OF EACH 1,000 OF 16 CANDLE POWER INCANDESCENT LAMPS INSTALLED.

	Residences.	Stores.	Public buildings.	Total.
Total installation	400	400	200	1,000
Maximum No. in use at any one time	200 325	350 350	150 25	700 700
Average winter load.				
5:30 p. m. to 9 p. m.	250	300	100	650
9 p. m. to 11 p. m.	150	100	50	300
11 p. m. to 5 a. m.	150	50	.....	100
5 a. m. to 7 a. m.	200	100	.....	300
Average summer load.				
7 p. m. to 9 p. m.	150	300	50	500
9 p. m. to 11 p. m.	150	100	50	300
11 p. m. to 5 a. m.	50	50	.....	50

Average yearly load.	Percentage of maximum load.
700 maximum load	100
575 lamps, 2 hours	84
300 lamps, 2 hours 300 lamps, 1 hour	42.8
75 lamps, 6 hours	10.7

A plant for the above purpose, it will be seen, will run on an average of more than one-half the time on about 11 per cent. of its rated load.

In small lighting plants, where only one machine is installed, low efficiency will result.

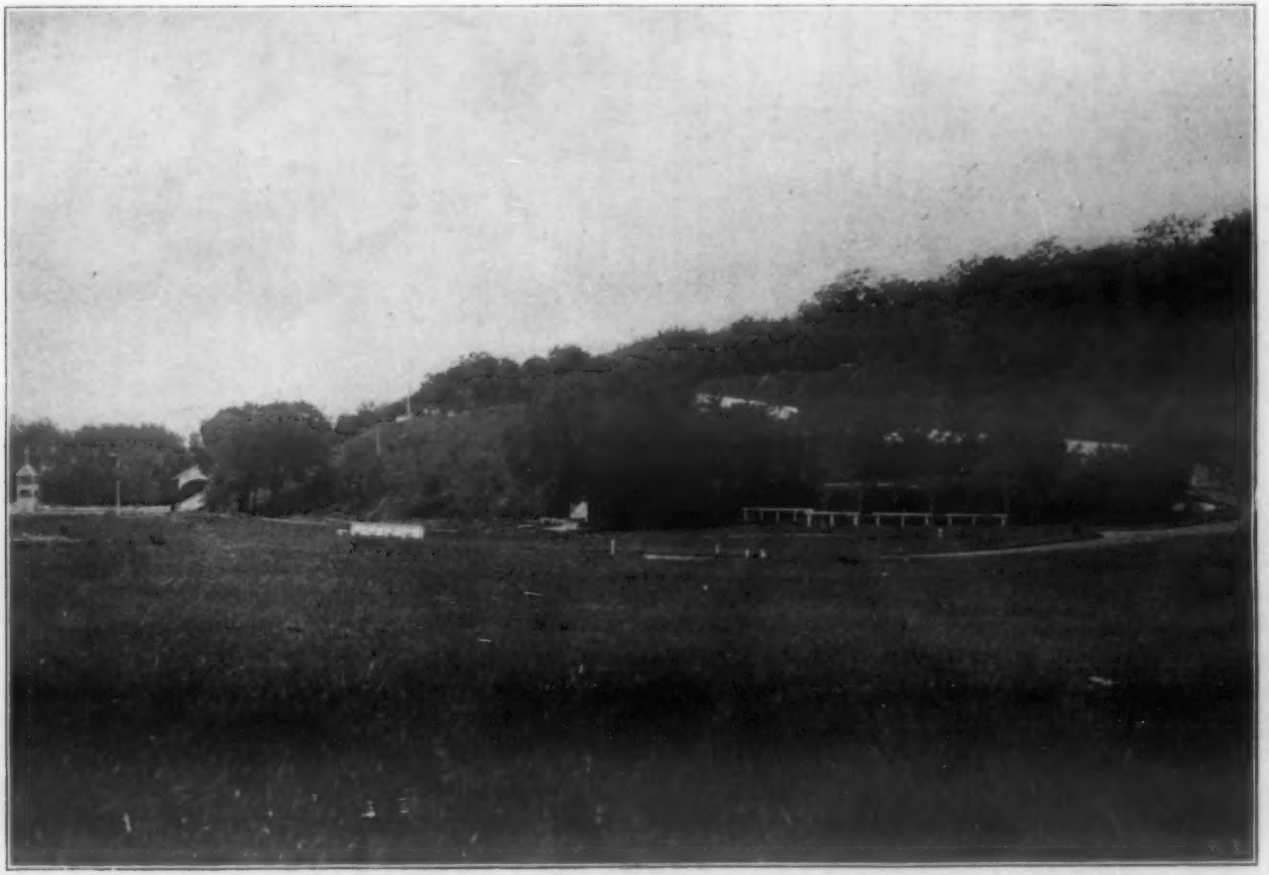
In large plants, where numerous machines are in use, extra machinery can be cut out or in to equalize the load and give a maximum efficiency.

On the careful consideration of these various factors depends the measure of success in every electrical installation.

CONCRETE FOR BUILDINGS.

One of the most promising fields for the use of Portland cement is in the construction of the walls of buildings. Isolated examples of concrete construction and of the use of cement mortar applied as a sort of stucco for the outside covering of walls, have been constructed at intervals in this country for many years. Many buildings in the older cement-producing countries are constructed almost entirely of cement concrete. The use of this material for buildings in this country is now rapidly increasing, and the demand for information regarding materials and methods of construction is great, while the amount of practical knowledge which has been put on paper is very small. The processes are so simple that it has hardly seemed necessary to the practical man to put his knowledge into shape to be of value to his fellow-workmen. Any one who has had experience in constructing foundations, piers or abutments, in which the use of forms is necessary for giving shape to the outer surfaces, has the fundamental principles well in hand, and can soon learn the best methods of constructing walls.

Simple framing of ordinary form and



SIBLEY MOUND, SIBLEY PARK, MANKATO, MINN.

strength is all that is necessary for massive walls, if the necessary scaffolding for the support of the workmen and apparatus as the work progresses, is provided for. The records of the patent office are beginning to show the activity of inventors in devising, framing and forms to meet the requirements of special constructions. The valuable patents in this line are listed from month to month in our column of "Recent Inventions," in the department of "Machinery and Trade."

One of the most recent is a framework consisting of vertical hollow metal standards properly braced together, the standards having vertical slots into which supports for concrete form boards can be inserted and clamped, and easily removed when the concrete is set. Another is a device for holding the form boards, consisting of vertical plates connected by a horizontal diaphragm. Rods pass through the wall to similar plates on the opposite side. The holders are made also of forms to fit the junctions with side walls or partitions, whether at right or other angles. The holders being placed in position on top of planks already in position, other planks are inserted on top and the concrete is filled in between. After it is set, the planks are removed and the rods passing through the wall are cut off or are removed and the hole filled with mortar. No framework other than the scaffolding for the workmen is needed.

Descriptions of the methods of construction of one or two buildings will show the ordinary processes followed. One of our illustrations shows two of the walls of one of the cement mills of the Lehigh Portland Cement Company, at West Coplay, Pa. The gable end is completed, ready to receive the roofing. The side wall is under construction. The framework supporting the form boards and the working platform is clearly shown. The framing is built up of scantling 3 inches by 6 inches and 3 inches by 8 inches, and 1½ inch boards are used for the concrete facing. The frames for the two sides of the wall are built up together and bolted together through the uprights, and the concrete is filled in between as the framework rises. When the concrete work is done the frames are taken down, the bolts are removed and the holes filled with cement mortar. The material in the frames and forms can be used many times over.

The proportions of the materials used in this building were 1 part Lehigh Portland cement, 4 parts sand, 8 parts crushed stone and 2½ parts rough stone; one barrel of cement making 1.35 cubic yards of concrete. As the concrete was deposited, the rough building stones, weighing from 30 to 50 pounds, were bedded in it, the concrete being well rammed about them. A cubic yard of the concrete was found to consist of 295 pounds of cement, 880 pounds of sand, 2,400 pounds of crushed stone and 700 pounds of rough building stone. These factory walls were left rough as they came from the forms, except about the windows, which were finished off with cement and sand. The walls can be smoothed somewhat by applying with a whitewash brush a coat composed of cement and lime. A much better finish can be given by plastering the surface with a mortar of 1 part Portland cement and 3 parts fine, sharp sand, using a mason's wooden trowel. The thickness of the walls varies with the height. One 45 feet high is 17 inches thick for the first 30 feet and 12 inches for the remainder. Those 16 to 25 feet high are 10 to 12 inches in thickness.

Another illustration shows the power plant of the Virginia Electric Railway and Development Company, at Richmond, Va., in process of construction. Cement concrete was used throughout this building. Portland cement concrete made 1 part cement, 2½ parts sand and 4½ parts broken stone was used for the piers and arches of the chambers in which the turbine wheels are set, about the draft tubes, for walls and their foundations, and for the finishing layers of floors. A mixture of 1 part Portland cement, 3½ parts sand and 7½ parts broken stone was used for canal walls and filling about arches. Some natural cement concrete was used in the less important and more protected places. The walls were made of concrete blocks, laid like ashlar masonry. The blocks were molded in boxes, and allowed to remain until set. They were lifted by means of irons running through them and bearing on thin iron strips imbedded in the bottom, as they were moved before their full strength was developed. Water tables, cornices, window courses and other special forms were molded separately in forms to give them their full architectural effect. The roof is of concrete, reinforced with expanded metal, covered with asphalted paper and slag concrete and supported on steel trusses and beams. The outer casing of the 175-foot chimney is of concrete, with an inner lining of brick, separated by an air space.

Our third illustration of concrete buildings shows St. James Episcopal Church, Brooklyn, N. Y., one of a number of recent constructions upon the Ransome system, using twisted steel bars embedded in the concrete to give additional strength. The

RIVER DRIVE, SIBLEY PARK, MANKATO, MINN.

rods in this case run both vertically and horizontally, and the concrete is deposited in the molds about removable wooden core pieces, making a hollow wall. Strips are nailed on the molds to produce the effect of joints and the desired face is given to the stones by the form of the surface of the mold, the desired finish being produced by the use of tools after the concrete has hardened. Window and door casings, water tables, string courses, cornices, etc., are specially molded and finished for architectural effect. Lehigh Portland cement was used in both these buildings.

Cement concrete forms an artificial stone, and this is some justification of the imitation of the architectural effects of natural stone. The best results of this imitation are quite pleasing, but the most satisfactory effects will probably not be obtained until special forms of architectural detail are developed, which are particularly adapted to the new material.

A special mold for putting concrete in place, used with success in building chimneys, is of interest. The mold is circular in form, one part encircling the chimney on the outside, and the other being parallel to it on the inside. Inside the chimney a scaffolding is erected to support vertical beams which extend about five feet above the top of the mold, when it is at its lowest position, and from which the mold is hung. Having been put in place, the two sections of the mold are tightened by turnbuckles, and the concrete is deposited between them with the iron rods of the Ransome system and wooden core blocks where cavities are desired. After the concrete has set, the turnbuckles are loosened and the weight of the mold is thrown on the supporting uprights. It is then raised by means of wheels turning on threads on the supporting rods. When so raised about five feet, the mold is clamped again and another section of the chimney is made. The mold is twelve feet long, so that seven feet of it is always in contact with a completed section of the chimney. One of these five-foot sections can usually be constructed each day.

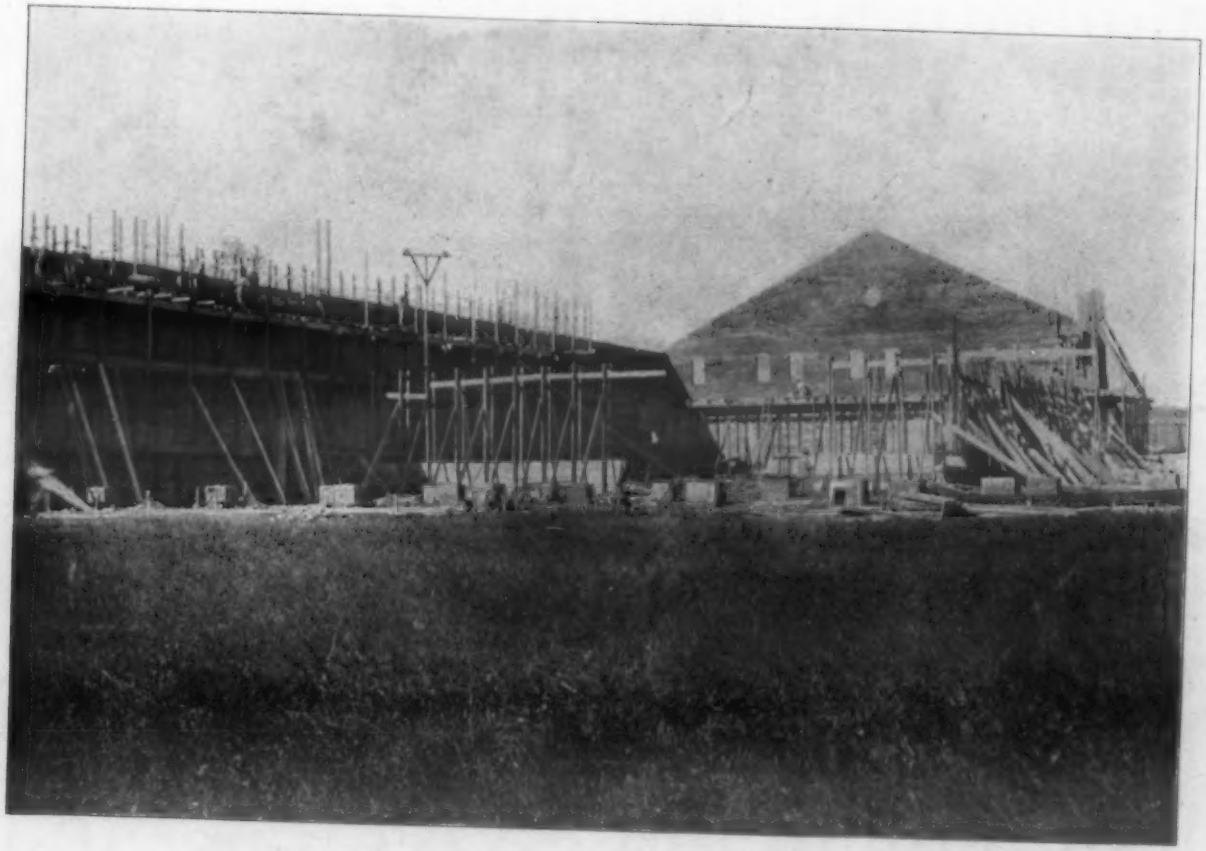
Articles on the use of various forms of metal strengtheners for concrete construction and on concrete for floors, and for fireproofing will appear in early numbers.

INTERURBAN RAILWAY FRANCHISES IN INDIANA.

The rapidly increasing importance of the interurban electric railway traffic warrants some discussion of the terms of franchises which have been granted, which may be of value to the officials of municipal corporations considering the granting of similar franchises. This month some of the franchises in operation in Indiana will be considered.

The provisions of the contracts with the interurban railways entering Indianapolis cover the operation of the lines concerned. The contracts, under the statutes, control the use of the tracks of the Indianapolis Street Railway Company, and therefore do not cover the subjects of construction and maintenance of tracks and lines. Cars must stop at all street crossings for passengers, but can not take on any baggage, express or freight, other than that carried in the hand, at such crossings. The time schedules fixed for the city railway must be observed; the city reserves the right to fix schedules for all companies, and provides in the contract for a car at least once in two hours between 6 A. M. and 11 P. M.

The contract provisions govern kinds of freight, express and baggage to be carried and times at which special classes may and may not be carried. For example, live animals can only be carried from the city limits to the Belt road, and lines not crossing that road can not carry live animals, such freight being limited to the time between 12:30 A. M. and 4:30 A. M. Until January, 1902, dead or spur tracks of the city railway may be used for loading and unloading, stops being limited to 15 minutes. After that date depots, into which the cars shall be run, are provided. Electric power only can be used, except by express permission of the city officials. First-class and efficient service is required, with approved motive power, cars, seats, ventilation, heating and electric light, all kept in good repair, attractively painted and decorated, and provided with life guards and modern safety appliances. Proper signs, showing destination, illuminated at night, are required. In case the company is hereafter permitted to construct lines in the city, or portions of its lines are included by annexation, the company may be required to pave between rails and tracks and 18 inches outside, and to keep pavement in repair in the same manner as the city railway company, and to keep tracks so that passengers will not suffer inconvenience or discomfort on



I. CONCRETE CONSTRUCTION. MILL B. LEHIGH PORTLAND CEMENT CO.

account of their condition. There must be no injury to city railway tracks by reason of condition of cars or mode of operation. Five cents fare may be charged within the city limits and no transfers are provided. Annually, during the first seven years of the franchise, the companies shall pay the city of Indianapolis 3 cents for each round trip of a car over the streets during the preceding year; during the next ten years 4 cents, and for the remainder of the franchise period 8 cents. Contracts with the Indianapolis Street Railway Company for the use of their lines and power must be agreed upon before the franchise becomes effective. No transfers of franchise or contract rights can be made without the city's consent. Ten thousand dollars bond is required, renewed from time to time as required by the Board of Public Works. Expiration of franchise period terminates all rights absolutely.

The franchise granted by the city of Fort Wayne for the interurban railroad to Huntington has all the provisions noted above, so far as applicable to an independent road, with a few changes: One requiring hourly cars between 5 A. M. and 12 midnight, an extra car or more if required, specially for service on the line within the city limits; less restriction as to kinds of freight; a depot; no compensation to the city for the first five years, $250 a year for the next five and $500 a year for the remainder of the fifty years' term of franchise; five cents for single fare within city limits, six tickets for 25 cents and twenty-five tickets for $1; pavement between tracks and rails and 12 inches outside; pavement and repair of bridge floors and culverts. In operation of road it has some additional requirements, such as conductors, with ample supplies of tickets; penalty of $10 a day for violation of any of the provisions of the contract concerning maintenance, operation or construction; assumption of damages for injuries to persons or property due to same, thus holding the city harmless; transfers to and from other lines in the city and equal division of city fares therefor; termination of contract on failure to construct and maintain the line to Huntington. In respect to the construction of the road, repair, and modification on order of the city, the provisions are long and greatly detailed, covering the exact route to be followed; the deposit of an emergency fund, to be kept always at $150, for the use of the city in repairing any dangerous defects requiring prompt action; provisions for use of tracks by other interurban companies on payment of rental, fixed at half the cost of construction and half the future cost of repairs, maintenance, repaving, modification, etc., cost of furnishing power to be added, or new company to use existing poles for supporting its new wires; the moving of tracks to any desired position on streets at any time upon due notice; the use of standard gauge and T or flanged rails of sufficient size to insure permanent track; tracks to conform to grades of streets and poles and wires not to interfere with other uses of streets; grades to be changed, when required, construction and repair of pavements, sewers, pipes or other improvements to be permitted, and aided in any way necessary; right of city to do work at expense of company if neglected after notice; necessary stoppage of cars by city without claim for damages; six-inch bed of concrete under whole length of ties on paved streets and reconstruction to this requirement on streets hereafter paved.

The city of Hammond fixes the streets to be used; the period of the franchise at 25 years; electric system, with overhead wires 18 feet above street level; cars each way every 30 minutes, from 6 A. M. to 10 P. M.; girder rails; 8 feet width for each track, measured from center of street; forfeiture of right to any street named, if at least a single track is not constructed in 5 years; forfeiture of franchise if certain lines are not built in one year; slag or cinder filling 8 inches deep, top level with tops of rails; five cent fare, with transfers, within city limits; ($2,000 payment by the original city railway company was required in the ordinance granting its franchise) free transportation to policemen and firemen in full uniform; guard wires, to protect telegraph and telephone lines. Amendments permitted T rails on certain streets, and require company to pay its proportion of macadam or other paving when street is paved. A franchise granted later to a second road has no restrictions except line to be occupied, girder rail, slag and cinder filling about tracks to make "good, passable road," two years' time to complete road, 20-minute schedule, 25 years' term of franchise.

Seymour gives the right to use certain streets. Alexandria regulates speed, 10 to 20 miles per hour. South Bend requires right of way to be paved when street is paved.

Elwood, in addition to the requirements of the original city railway, permits the interurban line, which succeeds to its rights, to carry freight, express and baggage, reserving the right to regulate the manner; requires construction of certain lines and remits requirement of daily service over

II. CONCRETE CONSTRUCTION. POWER PLANT OF VIRGINIA ELECTRIC RAILWAY AND DEVELOPMENT CO. RICHMOND, VA.

fair ground line. The city is paid ten dollars a year for each motor car used on the local lines only, and five dollars for each trailer thereto, but there is no compensation for interurban cars. These payments are in lieu of 2 per cent. of the net profits required of the city railway formerly.

The difficulties which have arisen in some instances from failure of companies to put and keep streets in good condition, and lack of provision for enforcing payment for repairing them, and the new troubles from the character of freight carried and the manner of handling it, show the necessity of careful provisions upon these points. The troubles about paving under city franchises will occur under interurban road franchises if full provisions are not made. Such matters of police power as control of stopping, standing of cars, speed, etc., can be taken care of in separate ordinances, but all questions of manner of construction, compensation, paving, and many questions of operation must be taken care of in the franchise. The Fort Wayne contract is worthy of close study. While some of its provisions might be made less onerous for small cities and towns, they are none too heavy for cities of the size of Fort Wayne, and are much to be preferred to the practical lack of control evident in some localities.

That the question of compensation for franchise has received no adequate consideration is shown by the great variation in amount and in kind of compensation required. The smaller cities and towns are many of them sufficiently compensated by the presence of the road, if it is placed under proper restrictions.

BACTERIAL PROCESSES OF SEWAGE PURIFICATION APPROVED IN ENGLAND.

The Royal Commission on Sewage Disposal, appointed in England about three years ago, has made a preliminary report showing the inefficiency of some kinds of land for sewage purification, and the inadequacy of the present methods of enforcing laws to prevent river pollution. Its most interesting statement is that regarding the use of processes of sewage purification depending upon the action of bacteria. The question asked, and the answer thereto, follow:

"Is it practicable uniformly to produce by artificial processes alone an effluent which shall not putrefy, and so create a nuisance in the stream into which it is discharged?

"The following general classification will serve to show the nature of the artificial processes to which we refer: Closed septic tanks and contact beds; chemical treatment, subsidence tanks, and contact beds; subsidence tanks and contact beds; contact beds alone; closed septic tank, followed by continuous filtration; open septic tank followed by continuous filtration; chemical treatment, subsidence tanks and continuous filtration; subsidence tanks followed by continuous filtration; continuous filtration alone.

"Many valuable experiments on artificial treatment have been made by a number of local authorities, and in particular the corporations of Leeds and Manchester have subjected certain processes to sustained observation. In this way much reliable information has been obtained. We are not, however, in a position to express an opinion upon the relative merits of the several artificial processes, nor can we at present make a compiete comparison between land treatment and artificial treatment of sewage, or state how far purification of sewage can be uniformly effected by one or another artificial process, and at what cost as compared with land treatment. The character of the sewage of different towns varies to a considerable extent, especially in respect to the amount and nature of the trade refuse mixed with the domestic sewage, but also in respect to domestic sewage itself; and a method applicable to one sewage might not be applicable to another. The problems involved in the matter are so many and so varied that only investigation, and, we may add, experience of a prolonged and varied character, will suffice to solve them.

"After carefully considering, however, the whole of the evidence, together with the results of our own work, we are satisfied that it is practicable to produce by artificial processes alone, either from sewage or from certain mixtures of sewage and trade refuse, such, for example, as are met with at Leeds and Manchester, effluents which will not putrefy, which will be classed as good according to ordinary chemical standards, and which might be discharged into a stream without fear of creating a nuisance. We think, therefore, that there are cases in which the local government board would be

III. CONCRETE CONSTRUCTION. ST. JAMES EPISCOPAL CHURCH. BROOKLYN, N. Y.

justified in modifying, under proper safeguards, the present rule as regards the application of sewage to land. No general rule as to what these safeguards should be can be laid down at present, and, indeed, it will probably always be necessary that each case should be considered on its own merits.

"As we have already said, sewage effluents must, in accordance with present knowledge, be judged not only from a chemical, but also from a bacteriological point of view. In order to safeguard public health, it is, in certain cases at any rate, not enough to know the chemical features of an effluent and to ascertain that it will not putrefy of itself; we must know the bacteriological features as well. Several witnesses have referred to the danger of allowing pathogenic organisms to enter streams which are used for drinking purposes, and our own officers are carrying out careful prolonged investigations on this matter. We are impressed with the great importance of the bacteriological questions which have arisen in the course of our inquiry, but we do not, at present, feel justified in putting forward any conclusions concerning them.

"We may, however, even at this stage, point out that as a result of a large number of examinations of effluents from sewage farms and from artificial processes, we find that while in the case of effluents from land of a kind suitable for the purification of sewage, there are fewer micro-organisms than in the effluents from most artificial processes, yet both classes of effluents usually contain large numbers of organisms, many of which appear to be of intestinal derivation, and some of which are of a kind liable, under certain circumstances at least, to give rise to disease. We are of opinion, therefore, that such effluents must be regarded as potentially dangerous, and we are considering whether means are available and practicable for eliminating or destroying such organisms, or, at least, those giving rise to infectious diseases."

EDITORIAL COMMENT.

Advances in Bacterial Sewage Treatment.

Most of the experimentation upon the septic or bacterial methods of purification has been carried on in England, where the more concentrated sewage increases the nuisance it creates, and the greater expense of suitable land makes reasonably complete purification very expensive. The local government board has complete control over the plans for sewage purification for all corporations which must borrow money for the construction of works, through its control of their borrowing powers. This board has followed the recommendations of former sewerage commissions in requiring land treatment of sewage whenever possible, aided by chemical precipitation when the area of land was necessarily restricted. The new processes, which have been developed in the last five years or so, have had scarcely any prospect of approval, and loans for their construction have been granted only for experimental purposes, if at all. This properly conservative attitude of the board has caused those interested in the new processes to carry their experiments out in great detail and with great care, and the necessities of the cities have aided them financially and otherwise in making their case as strong as possible.

The new sewerage commission was appointed in 1898 to consider what methods of sewage treatment may be adopted, what rules are necessary for determining the character of the method to be applied in any particular case, and to make recommendations. This commission has recently made a preliminary report in view of the pressing necessities of the day, in which it announces its conclusion that some kinds of soil are useless, or nearly so, as purifiers of sewage, and that there are bacterial methods whose effluents do not putrefy when discharged into streams. The text of this part of the report will be found on another page. In effect the conclusion amounts to a recommendation to the local government board to permit the use of bacterial methods, instead of chemical precipitation, and to modify the restrictions regarding the application of sewage to land when the local circumstances will justify this procedure. The prominence and technical ability of the members of the commission give its recommendation much weight, and undoubtedly the local government board will open the doors to such bacterial processes as prove themselves efficient purifiers of sewage.

This is quite a step forward, and while the full capabilities and the limitations of the various methods are not yet known, will give a great impetus to the construction of works upon a practical scale. Engineers in this country have been somewhat more

conservative in their approval of the new methods than have those in England, and their use in this country, under no legal restrictions, has not developed as rapidly as in England. This is partly due to our different conditions, more diluted sewage, streams not yet overloaded with drainage, cheaper and better land, and the like. The number is large, however, of our smaller cities, especially in the Mississippi valley, which are requiring sewerage, and which must devise some means of sewage purification before they can construct the sewers safely. The partial purification, to prevent putrefaction of the effluent after discharge into the stream, is all that is necessary for many of these cities, and the use of bacterial methods may be expected to increase rapidly. Their admission to English towns will have a marked effect in this country also in increasing the favor with which the new processes are regarded. We have already reported the results of the older experiments on this line in this country and will have several new works, now under construction or recently completed, to describe in the near future.

The Economic Theory of Pavements. The time is very nearly ripe for a thorough discussion of the economic theory of pavements, on the same broad lines as Wellington's upon railroads. A consideration of the manner in which recent text-books on roads and streets meet this need will be found in a review of them, which is in preparation for publication in this magazine. The appearance of an article in a contemporary, which attempts to lay down the basis for such a discussion, suggests some preliminary remarks. The necessity of possessing full knowledge of the results of past experience, and sufficient experiment upon new theoretical suggestions for construction to prove their adaptability to practice, is made prominent in the article in question.

Thus far there have been but few theorists in the broad field of pavement construction, though there have been many in restricted parts of it, like that of asphalt for wearing surfaces. Macadam's original statement of his fundamental theory has been repeated many times, seldom without approval. It asserts the ability of dry earth to carry any wheel load which can be applied, and thence concludes that the principal function of a pavement is to keep the subsoil dry, and that drainage facilities to remove and to keep water from the subsoil are essentials to permanence of roadways. Applied under the circumstances of his day, and to the materials, he considers his theory is as correct today as when it was stated. Special materials demand special treatment, and our modern advancement has emphasized the reduction of rolling friction. The vast increase in wheel loads on rails requires an additional restriction of the original statement, which had no loads to consider but those possible for wagons on flat tired wheels. In short, the theory is misapplied if it is carried beyond its original field, that of roads, and the attempt is made to cover the modern developments which require city pavements and steel tracks. Nevertheless, the most important features of a modern city pavement, as of the road of both ancient and modern times, are its drainage facilities and its ability to shed water. Smoothness in surface is a secondary consideration. Failure to drain a road or street properly causes greater expense in making the roadway capable of carrying its loads and in keeping it in condition. The difficulties arising from the use of broken stone, gravel or sand, as foundations, without cement, are due to failure to provide properly for one or the other of these necessities. Very seldom is it economical greatly to increase the weight of foundation to overcome deficiencies in drainage. Inequalities in pavements arise from unequal settlement of foundation, and this is caused by the deficiencies in the foundation or in its drainage, only in isolated instances developed by extreme loads. For the passage of one vehicle in perhaps millions is the ability of a pavement to distribute the load over the subsoil of prime importance. Except where heavy teaming is the rule, the economic theory of pavements would practically neglect this action of a pavement. If the prime requisites of drainage and impervious surface are provided, or deficiences in them are offset by extra foundation, the ordinary street will carry occasional extraordinary loads without injury.

Smoothness of surface is often a desideratum, but if it is obtained at the expense of slipperiness, it is not available for heavy traffic streets, nor for steep grades. Foothold for horses and durability require some pavement with sufficient joint room or roughness, and a hard and tough material, ordinarily stone or brick, local considerations of cost, availability, quality of material obtainable, etc., deciding between them. Depth of brick and stone must be about four inches, experience teaches, that the breakage from shocks may be as small as possible with economy in first cost and in repairs. Too large a brick can not be burned uniformly, so that the size of brick is limited to the economic depth of 4 inches, a

thickness of about 3 inches and a length such that warping in burning will not spoil too great a proportion of the kiln, and that cross breaking strains will not be too great. Good inspection of both stone and brick is economy, as it reduces the unevenness of wear, and prompt repair is economy, as it prevents the spread of wear from an occasional inferior block.

Among smooth pavements asphalt and wood are the most prominent candidates for favor, with brick second on account of its noise, and the various sorts of macadam following for roads and streets with light travel. Wood has not been popular in this country on account of the poor design and poor materials of the earlier pavements, but it has some advantages over all other pavements which, with proper design of pavement and treatment, make it popular in foreign cities and bid fair to increase its use in this country.

It is hardly possible to open the design of street pavements to competition as can be done in the case of bridges. The original construction is, too much of it, dependent upon local conditions, the action of materials is not sufficiently definite, the character of traffic can not be closely enough foretold, the action of the elements is too uncertain, the distribution of strains is too indeterminate to allow the classification of street pavements with bridges, in which the treatment of corresponding items is reduced almost to an exact science. The fact is that a very large proportion of the first pavements laid in our cities have been, and are still laid under the specifications and plans of contractors, and these early pavements are in large proportion defective. The failure of the early wooden pavements was due, not to the imposition of specifications upon the contractors, but to their defective plans and poor materials. Asphalt pavements were developed by more scientific promoters having control of the supply of material and owe their present position to these facts. In this case the contractors developed successful plans and have prepared the specifications in general use. The same course could not be pursued with any material not under a single control and will scarcely be possible with asphalt in the future.

New Hydraulic Formulæ.

The formulæ for the flow of water in pipes and channels are all of them unsatisfactory, as they do not give results agreeing with experiment under all circumstances to which they are supposed to be directly applicable. While the principles upon which the abstract theories of hydraulics are based are extremely simple, they are so modified by the internal action of water in motion and the interaction of water and the surfaces on which it runs that their practical application to flow in pipes is difficult. Our knowledge of these actions and interactions of water in currents is extremely vague, and our formulæ for the flow of water, being based upon few experiments under few conditions, and many of them by observers who were not practiced and who did not recognize the importance of full descriptions and notes, are correspondingly inaccurate for any conditions except those for which they were derived.

Most of the formulæ, those having the form $V = C D^x S^y$, can be defended by the same course of reasoning presented by Mr. Sullivan in his book, reviewed on another page of this number, and assume the velocity of flow to vary approximately as the square root of the slope, and as some function of the diameter or hydraulic mean radius, modified by a constant which depends upon the roughness of the wet perimeter. The exponent of the diameter is approximately that in Mr. Sullivan's formula, $\frac{3}{4}$, varying from $\frac{1}{2}$ to $\frac{3}{4}$, and that of the slope varies from $\frac{1}{2}$ to $\frac{1}{1}$. Some, like Mr. Sullivan's, are derived from theoretical considerations; others are modified from the theoretical formula to fit the results of observation.

Occasionally there is a specially elaborate set of experiments which gives some new information, almost always requiring some modification of existing formulæ, and in some instances materially modifying the ideas of the flow of water which have heretofore been held. A very notable recent instance of this sort is the set of experiments on the resistance to flow in bends in pipe made in Detroit and reported to the American Society of Civil Engineers at its first meeting in September, some notice of which we made in June.

Mr. Sullivan states the usual opinion in his usual definite fashion, thus:

"The resistance at a bend in a pipe or in an open channel is caused by the change of direction of the flow. The more abrupt the change and the greater the amount of the change in direction, the greater will the resistance be. It is evident, therefore, that the resistance will be directly as the number of degrees included in the central arc of the bend and inversely as the radius of that arc."

Mr. Williams states that the Detroit ex-

periments have shown that "curves of short radius, down to a limit of about 2½ diameters, offer less resistance to the flow of water than do those of longer radius, and hence that the theories and practices regarding curve resistance, as set forth in the hydraulic treatises of all nations up to the present time, are absolutely incorrect and the diametric opposite of the true conditions."

One is the inference from a theoretical consideration of the simple forces in operation, the other is a record of the modification of the action of these forces by the unknown and little understood laws governing movements of particles of water among themselves and in contact with other substances.

If as plain theoretical propositions as this are to be overthrown, it will be necessary to examine the ground upon which every formula for water in motion is based. It is quite necessary, therefore, to proceed with caution.

There have been so many formulæ derived from insufficient data, leading to constructions from observation of which material modifications were found necessary, that we must not make the mistake of rejecting a clear theoretical proposition without sufficient data to fully justify the step. Independent experiments by other engineers will be required to corroborate these results before they will be accepted by the profession generally. This will be no reflection upon the character of the work done by Mr. Williams and his associates, which is certainly of the highest class, and apparently without any modifying bias from preconceived opinions. The report has the great merit of presenting all the facts upon which the conclusions are based, so that the methods of observation and the deductions therefrom are all open to consideration.

A statement condensed from one in Mr. Sullivan's book giving, as is usual with him, his conclusions from his observations, without the full data from which his opinion is drawn, will be of interest here as showing the necessity of consideration of all the circumstances and the unexpected influence of conditions which may readily be overlooked. It is to the effect that large cast-iron pipes and small thick pipes are subject to greater variations in diameter on account of rougher casting, and that the co-efficient in the formula must be modified on account of this increase in roughness, so that the same formula will not apply to pipes less than 6 inches or more than 48 inches in diameter, which is used for pipes between those sizes.

A. S. M. I. The meeting of the American Society of Municipal Improvements at Niagara Falls, October 1-4, promises to be one of the most valuable conventions the society has held. Our readers who have not yet decided to attend would do well to take the next train to Buffalo and lend their presence, their membership, and their direct assistance to the society. It is in a field which is otherwise unoccupied, and has a membership largely composed of the most efficient and capable men of the country engaged in municipal improvements. Its annual gatherings are the mile posts marking the progress of the cities of the country in this department, and its volume of proceedings is always a valuable contribution to ngineering literature. Those engaged in municipal work or interested in municipal improvement are eligible to membership in some class.

A prospectus and program which, in the words of its preface, is "ornate and laudable" and "emphasizes its own encomiums and deserved eulogies," has been issued, and bears all the marks of the professional program publisher, who has been permitted to exploit his peculiar vocabulary in calling attention to his performance, and in indorsing and commending wholesale everything and every person connected with it. The program itself is excellent, as will be seen by reference to it on another page. The criticism is only upon the form of its publication. It is hardly probable that the society after this experience will again permit so great a reflection upon the dignity for which its proceedings heretofore have been noted, or so great a departure from its settled custom of consideration of persons and methods untainted by "unqualified and unreserved commendation" of any.

THE QUESTION DEPARTMENT.

COMPARISON OF COST OF BRICK, SHEET AND BLOCK ASPHALT.

Meadville has two principal business streets running north and south. On these streets are about two miles of macadam pavement which has been down for about twenty years. The entire driveway is 33 feet. Six feet on each side is filled with good Belgian block, the center with macadam. The street car track occupies the center. There is a deep foundation of broken stone under all. What would be the comparative cost per square yard for repaving with brick, asphalt block and sheet asphalt? Has the use of sheet asphalt on old macadam streets been a successful form of paving elsewhere? A small portion of one of the streets in the immediate vicinity of one of the railroad stations, and the terminus of one of these streets is now covered with asphalt block. All of the other paving in the city is brick. *McCoy & Calvin, Meadville, Pa.*

A very few old macadam streets have been covered with sheet asphalt, and the reports from these streets, early in their life, have been to the effect that they were satisfactory. So much depends upon the local conditions that a definite opinion can not be expressed without full knowledge of them. The narrow space between the car track and the Belgian block gutter suggests that the entire street be surfaced with sheet asphalt, if it is used, with the exception perhaps of a gutter strip two or three feet wide. Full detail of method of preparation of the surface to receive the coating of asphalt can not be given here, but one point may be mentioned. It is probable that the crown of the street, or the height of the street railway above the gutter is greater than would be desirable for a sheet asphalt pavement. Unless the railway is relaid, it may be necessary to raise the gutter so as to reduce this crown. This will probably require revision of the drainage facilities.

If the macadam strip is covered with asphalt block or brick, it would apparently be necessary to excavate the macadam four or five inches to allow for the thickness of the blocks and a cushion of sand to produce a uniform surface. The thickness of the macadam is probably sufficient to permit this. With proper attention to the junction of the asphalt block or brick pavement with the Belgian block, the latter need not be replaced. But the traffic will tend to run in a narrow strip each side of the car track, and thus wear the new part of the pavement in ruts. This is probably noticed in the present macadam.

Exact figures of relative cost are impossible to give without full knowledge of local conditions, including freight rates, competition among contractors, etc. Brick will probably cost the least for first construction, sheet asphalt next, and block asphalt the most; but the difference between the sheet and block asphalt is not great and is largely due to the excavation necessary to make room for the block. Brick may cost from 25 cents to 75 cents less per square yard than asphalt, according to quality and freight charges. The cost of excavation to make room for the brick would reduce the difference slightly. The total cost of sheet asphalt would be largely increased and the street be greatly improved by extending the asphalt covering part way over the Belgian block strips.

ASPHALT PAVING BLOCK MANUFACTURERS.

Will you kindly give us the name of firm or firms manufacturing concrete or asphalt paving blocks, and the machinery for manufacturing them?

Williams Patent Crusher and Pulverizer Co., St. Louis, Mo.

Compressed asphalt blocks and tile are made by the New Castle Asphalt Block Company, New Castle, Pa., and the Lake Erie Asphalt Block Company, of Toledo, Ohio. Both firms have offices also at 1016 Penn avenue, Pittsburg, Pa.

It is understood that patents for asphalt blocks and the machinery for manufacturing them are controlled by the International Block Company, of Baltimore, Md., W. S. Wilkinson, president.

MANUFACTURERS OF CEMENT ROOFING TILE.

Where are cement roofing tiles made in this country? *John Driscoll, Appleton, Wis.*

The American Cement Tile Company, formerly of Detroit, but now at Linden street and the Pennsylvania Railroad, Pittsburg, Pa., manufacture cement roofing tile. They have a Chicago office, also.

SPRINKLING ASPHALT PAVEMENTS.

Have you any available data or references regarding the effect of sprinkling asphalt pavements? I am informed that the practice has been abandoned in some cities on account of injury to the pavement.

M. W. Mix, Pres. Dodge Mfg. Co., Mishawaka, Ind.

Some four or five years ago there was considerable discussion of the effect of water upon asphalt pavements. Mr. Clifford Richardson, an expert upon asphalt questions, performed a number of experiments, and reported the results and the conclusions he drew in a series of articles in MUNICIPAL ENGINEERING, including one on "Softening Agents for the Production of Asphalt Cement for Paving and Other Purposes," page 343, June, 1897; "Chemical Constitution of Residuums and Malthas and its Relation to Water Action," page 1, July, 1897, and "Solubility of the Asphalt

Hydrocarbons in Heavy Petroleum Oil," page 67, August, 1897. The subject is also treated briefly in our question department on page 230, April, 1897, and page 94, February, 1899, and in an article by A. W. Dow on "Failures in Asphalt Pavements and their Causes," on page 20, January, 1900.

Mr. Richardson decides that the disintegration attributed to water on a pavement is due to mechanical causes, the pavement being unduly porous and admitting water, which in freezing disintegrates the pavement. This does not account, however, for the disintegration beneath when water gets in through the foundation, the surface remaining good. Nor does it account for the softening and disintegration of some asphalt mixtures which are not unduly porous, when soaked in water. It does account for the practice of asphalt paving companies who cover the gutters with a special asphalt paint to make them as nearly impervious as possible.

A paper before the Brooklyn Engineers' Club, by Whipple and Jackson, printed in their proceedings for 1900, discusses the effect of water upon asphalt in detail, and gives the results of a number of experiments. It suggests that the disintegration of asphalt pavements by water is due to the dissolving of some soluble salts in the asphalt or the other materials in the pavement, leaving a slight porosity, which permits disintegration by mechanical means.

There was at one time considerable discussion of the question whether sprinkling had the same effect as standing water on a pavement, and there were many conflicting reports of observations. So far as dissolving out soluble matters is concerned, the sprinkling would have some effect but not so much as standing water. In many places sprinkling has been abandoned, not so much because it injures the asphalt as because it does not do satisfactorily what is expected of it. The only reason for sprinkling an asphalt street is because it is dirty and the dust must be laid. Water thus applied only answers this purpose for a short time, when the dose must be repeated, and it increases the dirt nuisance in every other way. The best of the present methods of street cleaning are so satisfactory, and most of them are so easily applied, that the streets are more satisfactory if thoroughly cleaned. With one exception the cost of thorough cleaning is not materially greater than that of sprinkling, and is worth all it costs. This exception is that of a single paved street surrounded by an unpaved and sprinkled district. The dirt, in this case, is carried on faster than it can be removed, unless an excessively large force of men is employed. Even then cleaning is so much more satisfactory than sprinkling that a considerable extra expenditure for it can be justified.

MARL AND ROCK CEMENTS.

Would you please to inform me as to which is the best cement, a rock cement or a marl cement?

Evan J. Evans, Red Oak, Iowa.

There is considerable difference of opinion among the cement chemists as to which materials produce the best cement theoretically. The original materials, chalk and clay, for example, must be uniform in their chemical composition in order to produce uniformly good cement. Some deposits of marl and some deposits of clay have this uniformity. It is also true that some deposits of argillaceous limestone and of carbonate of lime have the proper uniformity. In such cases it is simply necessary to combine the materials in proper proportions in a thorough manner, and to burn and grind them properly in order to have a good cement. It is hard to say which of several rock and marl cements are the best. You will also find both rock cements and marl cements which are not satisfactory, either because the raw materials are not uniform in their chemical composition, or they are not mixed in the proper proportions, or they are not well manufactured. It will be found true, in some cases, that although the raw materials are not strictly uniform in their chemical composition, they are so closely watched during the process of preparation, and the proportions are changed so carefully to correspond with changes in composition that a good cement is the result. There is perhaps in general a little more likelihood of failure in uniformity in marl cements, because of greater variation in the chemical composition of the raw materials, but there are rock cements which are just as far from being uniform as the marl cements, and there are marl deposits which are surprisingly uniform in composition.

Portland cement was originally developed in England from mixtures of chalk and clay, and when it was found that uniform results could only be obtained from raw materials of uniform composition, it was decided that good Portland cement could not be made of any other materials than this uniform chalk and clay.

The lack of accessible deposits of these materials in some parts of Germany led to the development of the use of uniform deposits of marl and clay, and later to a careful watching of the raw materials by chemists

and a variation of their proportions in order that the final product might be uniform. The confidence of Mr. Saylor in the qualities of the argillaceous limestone of the Lehigh district, led to the development of methods of mixing and treating the remarkably uniform layers of rock in his quarries in proper proportions to produce a uniform Portland cement of high grade. The marl cements of Germany are, some of them, of the highest grade. Marl was first used in America because it had been successfully used in Germany. Some of the highest grade American cements are made of cement rock and limestone, and some are made of marl and clay. Likewise some cements which are irregular in composition and in properties are made of both classes of ingredients.

The first choice to be made is of a cement of properties suitable for the work to be done, and the second choice is of a cement which is uniform in composition and quality. The second requirement is of equal importance with the first. This choice can be made without knowledge as to the raw materials, but to the expert this knowledge aids in deciding which of the particular cements offered is most nearly suited to the conditions of the work under consideration. Each class of materials has its warm adherents and opponents, but the opinions seem usually to have been formed from experience with individual cements, and not from a thorough study of all the good brands of both classes.

FLOORS FOR WET CELLARS.

I would like to know what special precautions to take in laying a concrete floor in a basement in clay soil where we have water to contend with and there is a poor sewer. *George W. Clark, Marshfield, Wis.*

"The Directory of American Cement Industries and Hand-Book for Cement Users" ($5) gives in detail a good method of laying a cement floor where water must be contended with in considerable quantity, and can not be drained away, including drainage to a central sump, where the water can be pumped out during construction, using small tile drain in stone-filled trenches, brick paving laid in cement mortar, concrete floor, and final plugging of the sump-hole with brick and quick-setting cement mortar. This case may not require so elaborate a method of construction, as it should be possible to lead the water by small tile drains to the sewer, and thus relieve the pressure of water for most of the time. A porous foundation, sufficiently deep to insure that the water gets into the drains promptly, but compact enough to sustain the cement top coat, may be all that is necessary, the material being cinders, gravel or broken stone. The variations in temperature being slight, no allowance need be made, ordinarily, for expansion.

WARPING OF CEMENT WALK SURFACES.

I have had good success for a number of years in laying cement walks, etc., but last fall some of my best work warped up like boards in the sun, the edges of the top surface turning up and taking with them some of the concrete below, showing a crack in the concrete edgeways, in some places only a few inches and in some places nearly across the 6-foot sections, the bulk of the concrete remaining solid in place. Some of the cement used was German (Anchor, Stettin and Germania), but most of it was American Portland cement (Alpha).

1. The top course that warped was made of ⅓ cement and ⅔ crushed white quartz, with dust removed. Some walk was laid ⅓ cement, ⅓ crushed white quartz, and ⅓ sand, and none of this warped.

2. Some walk was covered and some was simply fenced off. For the first week or two they were wet down frequently, sometimes when the sun was shining hot on them.

3. The cement came in sacks and I think had got wet a little in transit. Some think the cement was not properly seasoned; others that perhaps it had too much free lime, or was not properly burned.

4. Some think the foundation course was laid too dry. It was made of gravel 7 parts to cement 1 part, same cement as in top coat.

5. I have recently been making expansion joints in the foundation, with about one inch of dry sand, and have let the top course go right over the sand joints.

I want to know what I have done that is not right, and what can be done to prevent the warping described. *Geo. W. Clark, Marshfield, Wis.*

The above has been condensed and arranged from two letters of Mr. Clark, describing in detail his difficulties. They have been put into five classes for consideration. Will not some of our readers give us the benefit of their experience on the points presented?

1. Crushed white quartz gives very little opportunity for close adhesion of cement, and mortar made of it is not altogether certain to adhere unless the quartz is crushed to the condition of sand and is thoroughly mixed, in which case the strength of mortar under tension is somewhat greater than that made with sand. This may account in some small degree for the trouble, but not to any great extent. Replacing half the crushed quartz with sand would make the proportions, one-half cement, one-fourth sand and one-fourth quartz. Perhaps a better mixture than any yet mentioned is one four-tenths cement, three-tenths sand and three-tenths crushed quartz.

2. Many walks, well-laid in all particulars, and of good materials, are left uncovered and are not wet down, and never give any trouble. Covering is a very proper precaution, sometimes saving a walk which

might otherwise give trouble, and wetting down is quite desirable for most jobs. The water should not be applied when the sun is shining, however. It is best applied in the evening after the walk has cooled off, or early in the morning, unless there is a covering so arranged that the water can be applied under it. The application of water to the hot walk may well be considered one of the causes of failure in this case.

3. The pulling apart of the foundation course would indicate the possibility of injury to the cement or defects of the sorts mentioned. The cements named seldom, if ever, have an excess of free lime, or are improperly burned. It is probable that the defects in the foundation are better explained in the following paragraph:

4. With proportions of 1 to 7 the amount of cement is too small, unless there is a large proportion of fine gravel and sand, of sizes well distributed, from the largest to the smallest, so that the proportion of voids left for the cement to fill is very small. Very thorough mixing is evidently necessary that the cement may be uniformly distributed through the entire mass. Proportions of 1 to 5 are safer, unless it is definitely known that the proportions of different sizes of gravel and sand are correct and the mixing is most thoroughly done. Nearly twice as much labor should be expended in mixing mortar of 1 to 7 as in mixing that of 1 to 5.

5. The top coat of the pavement receives the full force of the sun and is the part in which provision for expansion is most necessary. Each block should be a unit and the joints in the top surface should be made to correspond with those in the foundation layer. There will then be less tendency to separation and, if the top coat is put on before the lower layer has set, and the junction between them is complete, the stresses in the interior due to the greater tendency of the top to expand will not separate the top from the lower layer or cause the cracking of the lower layer as described. A half-inch of dry sand is quite sufficient for joint in the lower surface, and the joint in the upper surface should be made as near as may be on the same line.

The peculiarity in this case is the turning up or warping of the edges of the walk. The usual effects of high temperature reported are the rising of the top layer in the centre of the block, making a hollow sounding block, the rising of two blocks on the joints between blocks as hinges, and explosions of blocks where such rising is prevented. This case may perhaps be explained by paragraph 2, the application of water shrinking the top course so that it is of less area than the lower course, and by paragraph 4, the separated surfaces in the lower course not reuniting, and thus causing the edges of the walk to remain above the former level. The other conditions mentioned probably had little, if any, effect.

CEMENT STUCCO FOR WALLS.

Please let me know the proportions of cement and sand necessary for plastering on the outside of frame building, whether it is necessary to use metal lath instead of wood and how the work should be done. Should it all be put on in one coat, and if required to be made roughed or dashed, should the dash coat be applied before the first coat is dry?

C. B. Pruden, Tabor, N. J.

In the "Directory of American Cement Industries and Hand-Book for Cement Users" will be found full directions for mixing and applying cement stucco to walls. For the best work, vertical spruce laths, to which expanded metal lath are attached, are recommended. The stucco is put on in two coats, the first being one-half inch thick and composed of 1 part Portland cement, 2 parts medium and 1 part fine sand and ½ part lime flour. When this coat has set hard apply the second coat, one-quarter inch thick, with a wooden float, the mortar being made of 1 part of Portland cement, 1 part fine sand and 2 parts medium sand or crushed granite. The surface of the second coat can be roughed before it sets, or a dash coat can be applied, before hard set.

MIXING AND PLACING CONCRETE FOR BUILDINGS.

I write to inquire who manufactures the best small-sized mixer for concrete, not necessarily of the continuous pattern. Can you cite me to firms who are using gasoline engines for running small mixers? I would also like to know where to get approved methods and best up-to-date practice in the use of concrete for buildings.

C. M. Giddings, M. E., Rockford, Ill.

Reference to the Business Directory in our advertising columns will give the names of several makers of good concrete mixers of small size. The Cleveland Silex Stone Company, Hammond Building, Detroit, Mich., is using a small engine to run such a mixer on cement sidewalk work, apparently with considerable success. The use of concrete for making buildings is not yet sufficiently general to have required a book upon the subject, and there are very few articles upon the subject. MUNICIPAL ENGINEERING has several articles in preparation which will describe and illustrate the present practice. One of them will be found in this number and others will appear later.

CEMENT SIDEWALK TOOLS.

I am in need of a sidewalk jointer to block off my sidewalks into squares, one that can be adjusted to cut any depth, as I must cut the joints deep on account of the ground cracking so badly in dry, hot weather, that it makes the walks crack unless the joints are cut deeply, so that the cracking will follow them. *Subscriber, Terrell, Texas.*

The joints in the foundation course can be made with a straight piece of steel about 4 inches wide, $\frac{1}{4}$ inch thick and length of the shortest joint made, one edge being ground to a proper cutting edge, driven down with a mallet or tamper. Tools for making this joint, as well as the corresponding one in the wearing surface, can be obtained of W. H. Anderson & Sons, Detroit; The Contractors' Tool Co., Philadelphia; or Orr & Lockett Hardware Co., Chicago.

FLEXIBLE JOINT FOR IRON PIPE.

Will you please advise me who is the manufacturer of the Ward flexible joint for cast iron pipe?
Walter Bradley, Sup't Water Dep't, Fulton, N. Y.

The Ward flexible joint, which is mentioned in all the books on water supply, was devised by John F. Ward, many years ago, and can be obtained of him at 45 Broadway, New York. Other flexible joints are now on the market, but their names and descriptions have not yet found places in books on the subject of pipe laying. Some pipe foundries also manufacture flexible joints on similar lines, not patented, or on which the patents have expired. See the "Business Directory" in our advertising pages, under the headings of "Pipe" and "Water Pipe."

LAKE CURRENTS.

Can you give me a reference to any work on the study of currents in lakes?
Clark Olds, Erie, Pa.

For methods of investigating the subject and of determining the direction and velocity of currents reference may be made to an article by W. H. Hearding on "Lake Currents," in the Journal of the Association of Engineering Societies for July, 1892; one on "Temperature of Lakes," with special reference to smaller lakes, by Desmond Fitzgerald, in Transactions of the American Society of Civil Engineers for 1895; and one on "Marine Observations With Current Meters," by W. B. Dawson, in Engineering News, the second volume for 1895. An article by Wm. Starling, in Transactions of American Society Civil Engineers for 1895, on "Discharge of the Mississippi River," may also be of value in this connection.

With special reference to the Great Lakes, a study of the two editions of Bulletin B of the Weather Bureau of the United States Department of Agriculture will be of interest. These publications present the information obtained from floating a large number of bottles with papers enclosed and collecting and plotting the data of time and place of floating and picking up the bottles. The first edition, issued in 1894, gives the probable courses of the bottles picked up in 1892 and 1893, with some discussion of the results. The second edition, issued in 1895, adds the courses of the bottles picked up in 1894, some special drifts of logs, rafts, vessels, etc., omitting many of the special tracks of bottles to make room for the detail of the direction of currents deduced from the information at hand.

Some more or less detailed investigations on much smaller scale have doubtless been made in connection with the location of water-works intakes and sewer outlets at Chicago, Milwaukee, Cleveland and elsewhere, but no information of much value has been published except with reference to Toronto. The methods and apparatus used and the results obtained are described in the Transactions of the Canadian Institute of Engineers for 1891, volumes II and III.

HOW TO DIG A WELL IN SAND.

In search for more water for our town, we drilled through 6 feet of sand at a depth of 30 feet. There seems to be plenty of water. Should we dig a well 20 feet in diameter, how can we best overcome this sand? *J. W. Tavenner, Supt. Water-Works, Peabody, Kan.*

Perhaps the most satisfactory suggestion in response to this question is the following description of the method of sinking a 25-foot well 30 feet deep, sunk in sand and gravel, at Webster, Mass., followed by Frank L. Fuller, M. Am. Soc. C. E., engineer of the works, and reported in Goodell's "Water-Works for Small Cities and Towns" (§2).

"The excavation was made by driving 2-inch plank sheeting outside of ribs made of three or four thicknesses of 3-inch spruce plank, sawed to the proper radius and spiked together. The sheeting was in two courses, as the well was too deep for one. The water encountered during the excavation was removed by two 6-inch centrifugal pumps, the yield being about 1,000,000 gallons in twenty-four hours at a depth of 30 feet. After the excavation was completed, a 5-foot dry rubble wall was started, the thickness being reduced at a height of 3 feet to about 3 feet 8 inches by an inside off-set, which was used as a support for a 12-inch brick lining laid in cement. The rubble backing was gradually reduced in thickness to about 2 feet, the last 4 feet being laid in cement and pro-

tected by heavy coping stones, which bind the stone and brick work together, and make a foundation for the wooden roof of the well."

The chapter from which this extract is taken continues by saying:

"In sinking wells in sand containing a large amount of water it may prove advisable to make no attempt to keep the water out of the well," and giving methods of excavating for use in such cases.

GARBAGE DESTRUCTORS.

Can you refer me to a successful garbage consumer? *Subscriber, New York City.*

The consumption of garbage using no fuel but the material to be consumed has not been attempted except in very few places in this country. The reports from the Thackeray furnaces at Montreal and San Francisco, built on English models, are to the effect that they successfully perform their duties with very little if any additional fuel. A Lester furnace has been in operation in Atlanta for more than a year, from which good reports are heard, but some coal is necessary here. The Engle crematory has been selected for Milwaukee and the Decarie incinerator for Minneapolis, but the success of the new plants can not yet be determined.

PUBLIC CONVENIENCES.

Can you refer me to some place or places where I may see or get plans for public urinals or water closets? *J. W. Payne, City Engineer, Akron, O.*

Public conveniences are not yet introduced in the cities of the United States to any extent. The only instances which have come under the observation of the writer are one in a corner of the basement of the City Hall at Detroit, Mich., and one in an underground passage in Union Square, New York City. The former is probably in charge of the department of public works and the latter is probably in charge of the department of parks. All public parks have such structures and it is probable that the best examples in design, construction and maintenance will be found in the parks of the larger cities. Buffalo, Cleveland, Detroit, Pittsburg, Cincinnati, are most accessible to Akron. Address the department of parks or the department of public works in each of the cities named.

COST OF STRUCTURAL BRIDGE IRON.

Will you furnish a subscriber information concerning the cost per pound of structural bridge iron? *C. C. Huntington, County Surveyor, Eureka, Kan.*

The cost of structural steel varies irregularly. For some time the prices in Chicago have been about 1.75 to 1.85 cents a pound for I-beams and channels, 1.80 for tees, 1.75 for angles, 1.75 to 1.85 for universal mill plates. The prices at points in Kansas, not on the Missouri river, would be about 0.35 cent higher.

LOCATION OF GAS METER.

What part of the house is the best place to set the gas meter? If it is set in a warm room, will gas evaporate in any way from the meter? *Colin S. Cameron, Sarnia, Ont.*

The gas meter is set in the most convenient place without reference to temperature. If there is any trouble with condensation of moisture in the pipes in cold weather, it should be set so that the water will drain away from it, or be dropped into a chamber from which it can be drawn, especially if it is exposed to temperature below freezing point. If pipes and meter are tight, the temperature of the room has no effect in "evaporating" gas. Theoretically the gas would be expanded by heat and thus the candle power or amount of illumination in a cubic foot would be diminished, but practically this effect for any probable position of meter is zero.

THE COST AND DURABILITY OF BRICK PAVEMENTS IN ITHACA.*

By Prof. C. L. Crandall, Cornell University, Ithaca, N. Y.

In March, 1892, an amendment to the charter of the city of Ithaca was passed authorizing the common council to add to the general tax budget each year for ten years any amount they wished up to $20,000, for permanent street improvements. The amount so raised was to be kept as a separate fund and turned over to a pavement commission consisting of five members including the mayor. This commission was given full charge of the expenditure of the funds as to the streets to be improved and the character of the pavement or other improvement to be made. They could employ day labor or let the work by contract.

One-third the cost was to be assessed to the abutting property on each side, leaving only one-third the cost of paving the

*A paper before the League of American Municipalities.

blocks and the total cost of paving the street intersections, to be paid from this fund. The abutting owner could pay the full assessment at once, or in five equal installments, each payment after the first including all interest due. In the latter case the common council could issue bonds for the amounts due, and the funds obtained from their sale were to be turned over to the pavement commission.

Under this act the following amounts have been raised:

—Pavement Fund—

Year.	General. Tax.	Frontage Assessment.	Total.
1892	$ 19,996 33	$ 24,469 79	$ 44,466 21
1893	20,000 00	27,034 58	47,034 58
1894	10,000 00	10,481 17	20,481 17
1895	20,000 00	19,204 27	39,204 27
1896	15,000 00	9,407 02	24,407 02
1897	15,000 00	24,108 08	39,108 08
1898	15,000 00	27,755 42	42,755 42
1899	15,000 00	26,078 34	41,078 34
1900	15,000 00	28,761 11	43,761 11
1901	20,000 00	.....	20,000 00
Sale of stone 1897	.....	.....	499 57
Total ...	$ 164,996 33	$ 197,299 78	$ 362,795 68

At the beginning of the present fiscal year (March 1) frontage assessments to the amount of $14,130,78 were due in addition to the above, while $2,484.55 of the $15,000 put in the general tax budget for 1900 had not been turned over to the commission. Some 5 per cent. of the total frontage assessment is for water and sewer connections, laid to the curb, in advance of the paving. Allowing for this and also for the 1901 assessments the total invested in street roadway improvements during the ten years under this special act will amount to some $390,000. This has been invested in macadam, Medina sandstone and brick pavements; the larger portion in brick.

The itemized cost of the brick paving from year to year has been as follows: (See table on opposite page.)

These figures have been made up from the records of the paving commission. The prices for excavation per cubic yard, curbing per foot, brick delivered, concrete and laying, and total for paving only after the excavation has been made and the curbing set, are contract prices. The cost of excavation per square yard has been computed by dividing the total cost for the year by the paving yardage. The cost of sundries has been made up in the same way, including only the items which have been charged directly to specific portions of the work, such as stone headers at the junctions of cross streets, culverts and drainage pipe, changes of sewers, etc. The salary list and general expenses are not included. In making out frontage assessments the commission has included these at 30 cents per lineal foot of street, beginning in 1898. This for a thirty-foot roadway would be 1 cent a square foot or 9 cents a square yard, to be added to the total cost given in the table. The high total cost per yard in 1899 is due in part to the 5 cents increase in the cost of brick, but mainly to the grading of two side hill streets, Eddy and Stewart, with considerable rock cutting on Eddy, which brought the cost of excavation per yard of paving about 25 cents greater than the average for several preceding years. In 1900 the paving was done by day's work and no classification of the labor account is recorded. The streets were about like those paved in the years preceding 1899, and should have cost about the same for excavation and sundries. Beginning with 1897 the commission purchased the brick, delivered and piled upon the streets, under a separate contract.

With the exception of one block where the brick and sand were laid directly upon a regraded macadam roadway in 1896, all the brick have been laid upon a six-inch concrete base covered with a two-inch sand cushion.

The requirements for concrete have been Rosendale cement, mixed dry, one to two, with clean sharp sand, then wet and the broken stone added without gravel, dirt or stone dust. The original specifications allowed five parts of broken stone to be added to one of the cement and sand mortar; this was afterwards changed to four parts, again to two, and finally to an amount no greater than could be used and have the mortar fill the voids.

The earth bed is required to be rolled with a ten-ton roller before placing the concrete; and any filling to be made in six-inch layers and each rolled. The contractor has the use of the city steam roller at a nominal cost above running expenses.

The curbing is required to be of Medina sandstone, twenty inches deep and five inches thick, dressed ten inches on the face (afterwards changed to twelve inches) ten inches deep in the joints, the length to be at least thirty-six inches, and each stone to be backed with six inches of gravel when set.

The paving to be rammed, using a plank.

The 1892 specifications called for the joints to be filled with pitch. This was changed in 1893 after a portion of the year's work had been completed and a reduction in cost effected of about 10 cents per yard for the remainder.

A penalty clause of $20 a day liquidated damage for failure to complete the contract upon time was inserted in the early contracts, but not in the later ones.

A one-year guarantee has been exacted,

COST OF BRICK PAVING PER SQUARE YARD, NOT INCLUDING GENERAL EXPENSES.

Year.	CONTRACTOR.	Excavation. Cubic Yard.	Square Yard.	Sundries Sq. Yard.	Curbing Lin. Foot.	KIND OF BRICK.	Am't of Paving Sq. Yards.	Pavement Only. Brick Delivered.	Concrete and Laying.	Total.	Total Pavement Without Curb.
1892	Costello & Neagle..	$.40	$.18	$.03	$.70	Porter repressed...	4,186	$...	$...	$2.44	$2.65
1893-1	Costello & Neagle..	.40	.19	.04	.70	Porter repressed...	1,080	...	...	2.37	2.60
1893	Costello & Neagle..	.35	.16	.07	.69	Porter repressed..	12,577	...	...	2.15	2.38
1894	Campbell & Wood..	.31.9	.15	.07	.51.7	Newfield..	8,742	...	...	1.684	1.90
1895	T. McCord & Co....	.21	.08	.04½	.50	(McM. & Porter Repressed beveled Canton block)....	17,926	...	...	1.68	1.80½
1896-2	T. McCord & Co....	.27	.04	...	.50	Newfield	1,167	...	...	.97	1.01
1896	T. McCord & Co....	.27	.10	.02½	.50	(Canton block..... (Newfield. ....) (McM. Porter ....)	6,654 6,002	... ...	... ...	1.59) ....) 1.60)	1.72
1897	T. McCord & Co....	.21	.06	.05	.47	Newfield shale	11,578	.90	.53	1.43	1.54
1898	F. Spalding	.23	.08	.04-6	.40	(Johnsonburg Newfield shale).....	16,554	.90	.54	1.44	1.56
1899-3	F. Spalding	.23 (1.25)-4	.06	.03	.40 (.56	Newfield shale.....	3,052	.90	.54	1.44	1.53
1899	F. Spalding	(.25)	.31	.06	(.45	Newfield shale.....	15,371	.95	.54	1.49	1.86
1900	Day's Work	...	...	...	.46-5	Newfield shale.. ...	15,528	.90	...	....	1.68
1901	Coryell Const. Co....	.24	...	...	1.46	Corning.....		.81	.62	1.43	....

1-1892 contract with public omitted from joints for 7-10 of work.

2 laid on regraded macadam without concrete.

3-1898 contract.

4 rocks.

5 assumed, curb cost 34c f. o. b. Ithaca.

6 assumed, expenses not itemized.

and 10 per cent. retained for the period in order to make good any defective material or workmanship should the contractor fail to do so after due notice. In 1894 a five-year guarantee was given that the Newfield brick, which were just coming into use as pavers, would wear as well on Seneca-st. as the Porter repressed paving brick laid on Cayuga-st. in 1898 for the five-year period.

Rattler, cross breaking, crushing and absorption tests of the various brick samples submitted have been made from time to time, but only a few of the results are obtainable in the records of the paving commission.

In the later contracts there has been a clause requiring the employment of local labor so far as it could be obtained at 15 cents an hour until this year, when the requirement is made without regard to price.

Under the recent contracts the money collected from frontage assessments does not become due the contractor until the collection has been actually made or the money raised from the sale of bonds. It may thus be several years after the work is completed before the contractor receives full pay for it.

The Ithaca people believe in wide roadways; 30 and 36 feet between the curbs are the standards, with some as wide as 42 feet. The crown is from 6 to 8 inches above the gutters, and the cross section an arc of a circle.

The population of Ithaca as shown by the last census is about 13,000. The business portion centers about two blocks of state st. between Cayuga and Aurora-sts. The principal railroad depots are about a mile to the west, and they are connected by three brick paved streets, Buffalo, Seneca and Green, and by State, which has the electric railroad and is paved partly with brick and partly with Medina sandstone. Probably over one-half of the traffic from the depots and from the country to the west and northwest reaches the business center on Seneca-st. A considerable portion crosses over to State on Cayuga-st., leaving the Seneca-st. traffic lighter on the east of Cayuga-st. than on the west or depot side of it. Cayuga-st. extends north and south at right angles to Seneca and connects at one end with the leading approach from the country to the south and at the other with that from the north and northeast. It is also an important business street. The heaviest traffic in the city is believed to be in the vicinity of the corner of State and Cayuga-sts.

In order to obtain some idea of this traffic a record was kept by Mr. Charles G. Brown of all the teams passing on Seneca-st. east of Cayuga; on Cayuga between Seneca and State, and on State east of Cayuga from 5 a. m., hour by hour, until 10 p. m. for seven successive days, beginning Thursday, July 25, 1901. The classification used by the United States office of public road inquiries has been adopted.

blocks and the total cost of paving the street intersections, to be paid from this fund. The abutting owner could pay the full assessment at once, or in five equal installments, each payment after the first including all interest due. In the latter case the common council could issue bonds for the amounts due, and the funds obtained from their sale were to be turned over to the pavement commission.

Under this act the following amounts have been raised:

—Pavement Fund—

Year.	General. Tax.	Frontage Assessment.	Total.
1892	$ 19,996 33	$ 24,469 79	$ 44,466 21
1893	20,000 00	27,034 58	47,034 58
1894	10,000 00	10,481 17	20,481 17
1895	20,000 00	19,204 27	39,204 27
1896	15,000 00	9,407 02	24,407 02
1897	15,000 00	24,108 08	39,108 08
1898	15,000 00	27,755 42	42,755 42
1899	15,000 00	26,078 34	41,078 34
1900	15,000 00	28,761 11	43,761 11
1901	20,000 00	.....	20,000 00
Sale of stone 1897	.....	.....	499 57
Total ...	$ 164,996 33	$ 197,299 78	$ 362,795 68

At the beginning of the present fiscal year (March 1) frontage assessments to the amount of $14,130,78 were due in addition to the above, while $2,484.55 of the $15,000 put in the general tax budget for 1900 had not been turned over to the commission. Some 5 per cent. of the total frontage assessment is for water and sewer connections, laid to the curb, in advance of the paving. Allowing for this and also for the 1901 assessments the total invested in street roadway improvements during the ten years under this special act will amount to some $390,000. This has been invested in macadam, Medina sandstone and brick pavements; the larger portion in brick.

The itemized cost of the brick paving from year to year has been as follows: (See table on opposite page.)

These figures have been made up from the records of the paving commission. The prices for excavation per cubic yard, curbing per foot, brick delivered, concrete and laying, and total for paving only after the excavation has been made and the curbing set, are contract prices. The cost of excavation per square yard has been computed by dividing the total cost for the year by the paving yardage. The cost of sundries has been made up in the same way, including only the items which have been charged directly to specific portions of the work, such as stone headers at the junctions of cross streets, culverts and drainage pipe, changes of sewers, etc. The salary list and general expenses are not included. In making out frontage assessments the commission has included these at 30 cents per lineal foot of street, beginning in 1898. This for a thirty-foot roadway would be 1 cent a square foot or 9 cents a square yard, to be added to the total cost given in the table. The high total cost per yard in 1899 is due in part to the 5 cents increase in the cost of brick, but mainly to the grading of two side hill streets, Eddy and Stewart, with considerable rock cutting on Eddy, which brought the cost of excavation per yard of paving about 25 cents greater than the average for several preceding years. In 1900 the paving was done by day's work and no classification of the labor account is recorded. The streets were about like those paved in the years preceding 1899, and should have cost about the same for excavation and sundries. Beginning with 1897 the commission purchased the brick, delivered and piled upon the streets, under a separate contract.

With the exception of one block where the brick and sand were laid directly upon a regraded macadam roadway in 1896, all the brick have been laid upon a six-inch concrete base covered with a two-inch sand cushion.

The requirements for concrete have been Rosendale cement, mixed dry, one to two, with clean sharp sand, then wet and the broken stone added without gravel, dirt or stone dust. The original specifications allowed five parts of broken stone to be added to one of the cement and sand mortar; this was afterwards changed to four parts, again to two, and finally to an amount no greater than could be used and have the mortar fill the voids.

The earth bed is required to be rolled with a ten-ton roller before placing the concrete; and any filling to be made in six-inch layers and each rolled. The contractor has the use of the city steam roller at a nominal cost above running expenses.

The curbing is required to be of Medina sandstone, twenty inches deep and five inches thick, dressed ten inches on the face (afterwards changed to twelve inches) ten inches deep in the joints, the length to be at least thirty-six inches, and each stone to be backed with six inches of gravel when set.

The paving to be rammed, using a plank.

The 1892 specifications called for the joints to be filled with pitch. This was changed in 1893 after a portion of the year's work had been completed and a reduction in cost effected of about 10 cents per yard for the remainder.

A penalty clause of $20 a day liquidated damage for failure to complete the contract upon time was inserted in the early contracts, but not in the later ones.

A one-year guarantee has been exacted,

COST OF BRICK PAVING PER SQUARE YARD, NOT INCLUDING GENERAL EXPENSES.

Year.	CONTRACTOR.	Excavation. Cubic Yard.	Square Yard.	Sundries Sq. Yard.	Curbing Lin. Foot.	KIND OF BRICK.	Pavement Only. Am't of Paving Sq. Yards.	Brick Delivered.	Concrete and Laying.	Total.	Total Pavement Without Curb.
1892	Costello & Neagle..	$.40	$.18	$.03	$.70	Porter repressed...	4,186	$...	$...	$2.44	$2.65
1893-1	Costello & Neagle..	.40	.19	.04	.70	Porter repressed...	1,080	...	...	2.37	2.60
1893	Costello & Neagle..	.35	.16	.07	.69	Porter repressed..	12,577	...	...	2.15	2.38
1894	Campbell & Wood..	.31.9	.15	.07	.51.7	Newfield..	8,742	...	...	1.684	1.90
1895	T. McCord & Co....	.31	.08	.04½	.50	(McM. & Porter Repressed beveled Canton block)....	17,926	...	...	1.68	1.80½
1896-2	T. McCord & Co....	.27	.04	...	.50	Newfield	1,167	...	...	.97	1.01
1896	T. McCord & Co....	.27	.10	.02½	.50	(Canton block..... (Newfield. ....) ..... (McM. Porter ....)	6,654 6,002	... ...	... ...	1.59) ....) 1.60)	1.72
1897	T. McCord & Co....	.21	.06	.05	.47	Newfield shale ....(Johnsonburg Newfield shale).....	11,578 16,554	.90 .90	.53 .54	1.43 1.44	1.54 1.56
1898	F. Spalding	.23	.08	.04-6	.40	Newfield shale.....	3,052	.90	.54	1.44	1.53
1899-3	F. Spalding	.23 (1.25)-4	.06	.03	.40 (.56						
1899	F. Spalding	(.25)	.31	.06	(.45	Newfield shale.....	15,371	.95	.54	1.49	1.86
1900	Day's Work	...	...	...	.46-5	Newfield shale.. ..	15,528	.90	...	....	1.68
1901	Coryell Const. Co....	.24	...	...	1.46	Corning.....		.81	.62	1.43	....

1-1892 contract with public omitted from joints for 7-10 of work.
2 laid on regraded macadam without concrete.
3-1898 contract.
4 rocks.
5 assumed, curb cost 34c f. o. b. Ithaca.
6 assumed, expenses not itemized.

and 10 per cent. retained for the period in order to make good any defective material or workmanship should the contractor fail to do so after due notice. In 1894 a five-year guarantee was given that the Newfield brick, which were just coming into use as pavers, would wear as well on Seneca-st. as the Porter repressed paving brick laid on Cayuga-st. in 1898 for the five-year period.

Rattler, cross breaking, crushing and absorption tests of the various brick samples submitted have been made from time to time, but only a few of the results are obtainable in the records of the paving commission.

In the later contracts there has been a clause requiring the employment of local labor so far as it could be obtained at 15 cents an hour until this year, when the requirement is made without regard to price.

Under the recent contracts the money collected from frontage assessments does not become due the contractor until the collection has been actually made or the money raised from the sale of bonds. It may thus be several years after the work is completed before the contractor receives full pay for it.

The Ithaca people believe in wide roadways; 29 and 36 feet between the curbs are the standards, with some as wide as 42 feet. The crown is from 6 to 8 inches above the gutters, and the cross section an arc of a circle.

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The average daily traffic was distributed as follows:

	Seneca.	Cayuga.	State.
1. Loaded one-horse wagon	95	231	290
2. Unloaded one-horse wagon	53	97	108
3. Loaded two-horse wagon	56	77	79
4. Unloaded two-horse wagon	88	72	57
5. Loaded four-horse wagon	0	9	0
6. Unloaded four-horse wagon	0	1	1
7. One-horse pleasure vehicle	156	277	266
8. Two-horse pleasure vehicle	33	54	61
9. Rubber-tired vehicle	18	39	25
10. Unharnessed horse or shod ox	4	6	5
11. Excessively heavy vehicle	47	32	32
Total daily	550	886	924

The night traffic between 10 p. m. and 5 a. m. is very light, but no record has been taken of its amount.

It may be noted in this connection that Mr. Brown, in order to see if the bicycle traffic had nearly disappeared, recorded the number passing on Cayuga-st., Tuesday, July 30. He found 1,380, as compared with 961 other vehicles, or 43 per cent. more bicycle traffic than all the other roadway traffic combined, on the basis of the number of vehicles.

This Cayuga-st. block, between Seneca and State, was paved in 1892 with Porter repressed brick by Costello & Neagle and it has thus been in use about nine years. The average daily traffic for the nine years has probably been less than for the recorded week in July, or less than 886.

The wear of a brick pavement begins at the corners of the brick, widening the joints by wear and chipping; if the bricks are brittle some of them will break in halves, while large pieces will break from the ends and corners of others; next there is unequal settlement over ditches and other filled or soft spots; afterward the upper surfaces begin to wear flat, diminishing the thickness of the joints; this wear is more or less in spots, due to soft brick or to the concentration of blows on account of roughness and large end joints, or to both causes. The more these depressions are localized the rougher the pavement and the heavier the blows delivered to it by the wheels and the more rapid the wear, until finally the pavement becomes too rough for use, or the thinnest portions break up.

At just what stage renewal will be made in a given case is difficult to predict, as it will depend upon the importance of the street, the feeling of poverty or wealth prevailing at the time, and the attitude toward cleanliness and proper sanitation.

With these preliminary remarks it may be stated that the chipping of the corners and the local settlement are both small on this Cayuga-st. block. There were twenty-three bricks with broken corners noted in walking once along the center of the roadway for the length of 200 feet. Some 5 per cent. of the bricks have considerable top wear, with a few depressions cut from one-half to three-fourths of an inch deep. The joints along the central portion average about one-half inch. Considering the location with reference to the business center it is believed that this pavement will be renewed by the time the total traffic has been doubled, or that the pavement is about one-half worn out.

The adjacent blocks on Cayuga-st., both north and south, were paved in 1893 by the same contractors and with the same brand of brick, but with sand-filled rather than asphalt joints, except for a portion of the adjacent block on the south. The portion to the north has larger joints, more local settlement and more chipped and broken bricks, but less top wear. On the first 200 feet there were some fifty bricks broken in the center. On the first block south there are but few broken or chipped bricks, the surface is fairly smooth, the wear small and the local settlement not great. The traffic is probably less than on the block between State and Seneca, but greater than on the block north of Seneca. The total traffic will probably be more than doubled before this pavement will be replaced.

Two other blocks were paved in 1892 by the same contractors and with the same brand of brick; State-st., east of Aurora, and Aurora south of State, both at the southeastern limits of the business center and on thoroughfares to the adjacent country. Both of these blocks have been dug over considerably in laying sewer and water pipes, but they are in better condition than the State-Seneca-st. block on Cayuga-st. The west end of the State-st. block is beginning to show the characteristic top wear on soft brick, and to become correspondingly rough, but the condition has not become general. Over the electric railroad the settlement between the ties has made the pavement very rough. The traffic is probably considerably lighter than on State-st. at Cayuga, but not so light as on the Aurora-st. block.

In 1894 Seneca-st. was paved by Campbell and Wood from Aurora-st. to Plain, under a contract for Newfield brick which was afterwards modified to allow of the purchase of other brick in part. On the block having the daily traffic of 550 there were eighty broken brick noted in walking once over the block, a distance of about 530 feet The tops are worn in places one-third to one-half an inch deep, making general de-

pressions as well as local ones and a rough street in sections. There are considerable local settlements. On the block to the east of this the top wear on the soft brick is from one-half to three-fourths of an inch, while there are holes two inches deep due to wear and settlement. The brick are not badly broken. The joints on both these blocks are small. It is believed that the first block, Cayuga-Tioga, is over one-half worn out and that the second block, Tioga-Aurora, is about two-thirds worn out. On the portion west of Cayuga-st., extending to Plain-st., it is believed that the pavement is not quite half worn out.

In 1895 Canton paving blocks, showing 3 by 9 inches, with rounded corners, were laid on two blocks on Green-st., and in 1897 Canton blocks showing 3½ by 8 inches were laid on several blocks on State-st. They are giving good service except that broken ends are quite noticeable in riding over the street.

The brick laid on Aurora-st. in 1896 upon the regraded macadam roadbed without concrete is preserving as good a surface, so far as settlement and wear are concerned, as any of the brick pavements.

Some of the standing places for horses show serious chipping of the corners of the bricks, making wide joints, but with little top wear.

A portion of the brick pavement laid on Aurora-st. in 1892 was on a 10 per cent. grade. This was quite slippery at first, but complaint soon ceased. Grades of about 9 per cent. were used on the Eddy-st. pavement in 1899, and this takes most of the heavy teaming to the university.

In closing it may be said that the experience with brick paving in Ithaca extends over a period of nine years. During that time the cost of the concrete, sand and brick in place has gradually been reduced from $2.44 per square yard in 1892 to $1.48 in 1901. The total cost outside of the general expenses estimated by the commission for several consecutive years at 30 cents a lineal foot of street, has been reduced from $2.65 in 1892 to $1.63 in 1899; the price for the bulk of the work in 1899 being higher on account of rock excavation and a slight rise in the cost of bricks, and in 1900 on account of the work being done by the city. These reductions in cost have been effected under practically the same specifications, with the exception of the pitch or asphalt joints, which reduced the price 10 cents per square yard. On the heaviest traffic streets of a town of 13,000 inhabitants, only a small proportion of the pavement is one-half worn out with from seven to nine years' service. Good results have been obtained upon regraded macadam without concrete. Brick can be used up to 9 per cent. grades with no difficulty, except in frosty or icy weather.

ST. LOUIS WATER-WORKS—DISTRIBUTION SYSTEM.*

By Ben C. Adkins, Water Department, St. Louis, Mo.

The distribution system of the St. Louis water works in 1886 was as follows: 278.9 miles of pipe in service, 2,685 fire plugs in service, 2,518 stop valves and 29,834 taps. The average daily consumption was 26,901,000 gallons. A cross-section taken at the towers showed a carrying capacity equal to that of two 36-inch pipes, and a cross-section taken in the business district showed a carrying capacity equal to that of 2.1 thirty-six-inch pipes. The city at this time had its pumping stations at the foot of Grand-ave., comprising a low service division with a total pumping capacity of fifty million gallons in twenty-four hours, and a high service station with a total pumping capacity of seventy-four million gallons in twenty-four hours.

At the present time the low service division is located at the Chain of Rocks and has a total pumping capacity of one hundred and sixty million gallons in twenty-four hours. A new high level station has been erected at Baden designed for a total pumping capacity of eighty million gallons in twenty-four hours. The last two of six engines are now being erected. The old high service stations at Bissell's Point are still in service and will have, when remodeling has been completed, a total pumping capacity of 118,000,000 gallons in twenty-four hours. The distribution system comprises at the present time 638.2 miles of pipe in service, 7,325 fire plugs, 6,557 stop valves and 67,243 taps; the average daily consumption being 63,000,000 gallons. Cross-sections taken at places corresponding to those taken in 1886 show at the Towers a carrying capacity of 6 thirty-six-inch pipes and through the business district a carrying capacity of 6.2 thirty-six-inch pipes.

The following table gives a comparative

*A paper before the American Water Works Association.

statement of the different sizes of pipe in service in 1886 and 1901:

Sizes.	Miles— 1886.	1901.
48-inch	0.19	0.23
36-inch	8.46	20.25
30-inch	5.58	22.26
20-inch	19.81	57.69
15-inch	8.65	10.13
12-inch	21.37	118.39
10-inch	9.03	9.47
8-inch	3.75	10.92
6-inch	187.78	375.61
4-inch	1.81	1.82
3-inch	12.52	11.45

The maintenance of the system is performed by what is termed a Street Service Department. In 1886 the net cost of operating this department was $40,693.13. This cost included the cleaning, oiling and packing of 9,152 fire plugs, 6,048 valves, digging 105 leaks and repairing 91 fire plugs. In 1901 the net cost of operating this department was $92,582.72. This cost included the cleaning, oiling and packing of 22,156 fire plugs and 14,349 stop valves, digging 314 leaks and repairing 2,133 fire plugs. Of the repairs of fire plugs 353 were on account of the general usage and 1,780 on account of the use by street sprinklers. The latter statement is given to show how repairs of fire plugs have increased owing to their use by street washers and sprinklers. Though nothing serious has happened in the way of fire plugs being out of condition in case of fire, still past experience is no criterion of safety and the use of fire plugs for any other than fire service should be condemned.

About the year 1890 a series of breaks in the large mains in the vicinity of the towers led to an investigation of the cause, the conclusion being that the accidents were due to accumulation of air unable to free itself. Where profiles had not been kept the department was obliged to expose the mains every twelve feet in order to locate the air points. This being done, air taps and fire plugs were set in order to bleed the air from the mains, the result being that since then few or no breaks have occurred. This experience taught us that air is one of the most, if not the most, important factor to deal with in the distribution system and that too little attention is paid by the inexperienced engineer to laying out his grades, the result being that the corporation or municipality pays for the difference in cost in the end. Our practice now is to connect our large mains to the smaller distribution pipes at the air points, where it is possible to do so. Where such connections are not feasible a chamber of 6-inch or 12-inch pipe, 100 feet or more in length, is laid parallel and above the large mains as a receiver for the air, which is freed by means of air valves or the blowing off of fire plugs.

Beginning in 1886 the idea of blocking the distribution system was adopted and has since been carried out. The system of by-passing has also been adopted, thereby saving a valve and preserving the continuity of the flow in the pipe in case of shut-offs.

As will be seen by the tables, the system has quite a number of stop valves, the object being to make the average shut-off not more than five blocks long, and in the business districts not over two blocks, thereby reducing the number of protests from consumers and affording a better protection in case of fire. Pressure surveys are made every two years, twenty-four-hour records being taken at different points of the system, the object being to keep track of its operation. At the same time gauges are kept at different points where continuous records are made.

Aside from the fact that a duplicate set of records is kept, both in books and on maps, a card system for quick reference has been prepared, showing the locations of fixtures at street intersections. The east and west streets are taken as the main indexes and the streets where large mains cross as sub-indexes. The latter serve, not only to locate large mains, but also as aids in more quickly locating the intermediate intersections.

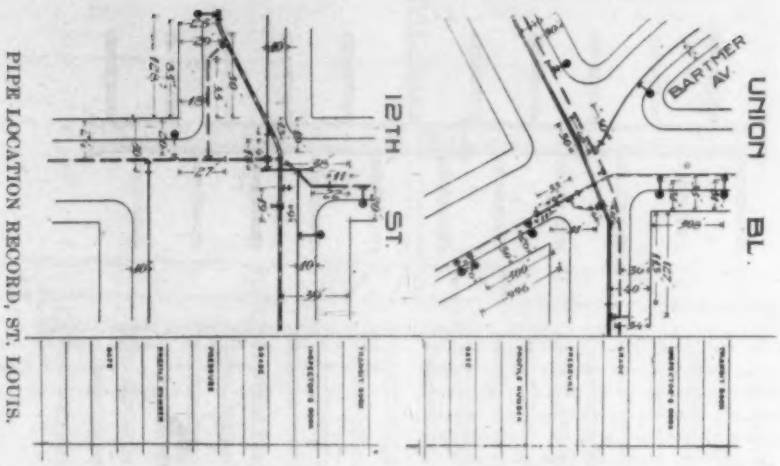
The following sketches are duplicates of the cards now in use. See opposite page.

The effect of electrolysis has been felt in several localities, especially in the vicinity of power stations. While the damage done has not been very great as yet, steps must soon be taken to lessen, if not to stop it entirely. There is no question but that the action is slowly going on, and disastrous as well as expensive results are looked for.

The question of metering of service pipes has been agitated lately, owing to the rapid increase of consumption and the growing demand for filtration. The water department now furnishes water free to the city institutions, for fires, street sprinkling and washing, and for flushing of sewers. This heavy draught being for the public benefit, consumers should certainly not object to the establishment of an equitable basis of payment for their individual supply.

The introduction of a meter system would not only greatly reduce the present enormous waste, but would have its most beneficial effect in materially lengthening the life of the present capacity of the water works.

The pressure furnished in the business districts now averages from 45 to 50 pounds, and in the high level residence district it ranges from 45 to 100 pounds, the maximum elevation supplied being 200 feet above the city directrix. The average number of fire plugs per mile in the system has been increased during the past year from 11.23 to 11.48. A district between Cass and Chou-



teau-aves., and from the river to Jefferson ave., or ½ square mile of business territory, has 1,345 fire plugs. A cross section taken through Washington-ave., which is probably the center of this district, shows a carrying capacity into this district equal to that of three 36-inch mains.

The appended table shows the growth of the distribution system from 1886 to the present time.

Table showing the growth of the distribution system St. Louis (Mo.) water works:

Year Ending	Miles of Pipe.	Fire Plugs.	Stop Valves.	C. V.	B. O.	Air Taps.	Taps.	Meters.	Water Pumped.
1886	279	2,685	2,518	41	58	32	29,884	2,143	9,817,943,000
1887	295	2,922	2,668	63	54	35	31,794	2,376	10,877,896,000
1888	314	3,161	2,854	68	57	43	34,022	2,662	11,520,608,000
1889	336	3,366	2,991	70	66	58	36,082	2,888	11,481,771,000
1890	354	3,515	3,148	67	76	63	38,183	3,115	11,863,457,000
1891	373	3,715	3,306	67	76	66	41,331	3,399	13,144,565,000
1892	393	3,916	3,483	68	79	66	44,382	3,601	14,453,390,000
1893	410	4,103	3,613	68	81	66	47,445	3,750	16,140,476,000
1894	447	4,504	3,915	70	87	68	50,540	3,850	17,366,270,000
1895	426	4,690	4,077	70	90	66	53,354	3,979	20,030,271,000
1896	493	5,020	4,383	73	103	66	56,865	4,092	19,542,768,000
1887	532	5,447	4,776	73	109	68	59,423	4,198	18,653,013,000
1898	555	5,723	5,094	76	138	89	61,839	4,151	20,366,176,000
1899	581	6,325	5,704	92	156	89	63,851	4,161	20,800,292,000
1900	616	6,920	6,163	83	159	89	65,688	4,133	22,114,261,000
1901	638	7,325	6,557	80	162	89	67,243	4,331	22,993,668,000

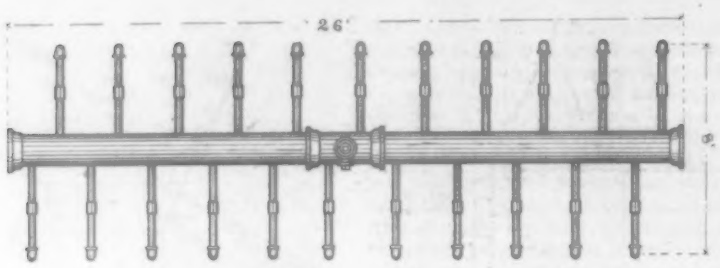
DRIVEN WELLS FOR FIRE PURPOSES.

By John C. Spencer, Chief of Fire Department, Janesville, Wis.

Where the ground water is within reach of the suction of a fire engine and the well points can terminate in gravel, the following construction of a well for fire purposes, as used in Janesville, will be found successfu' and an improvement upon cisterns:

Excavate the earth to the level of the water, where the excavation should be not less than twenty-eight feet long by fourteen feet wide. This excavation can be done with scrapers. Tight sheet the sides for two or three feet deeper, and resume

*From a paper before the International Association of Fire Engineers.

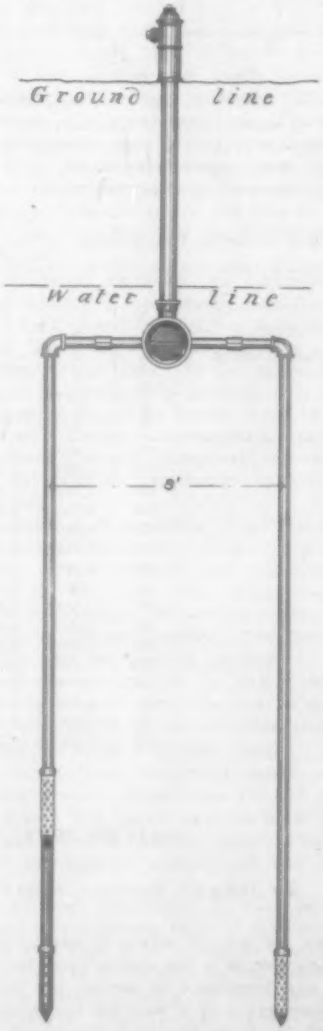


PLAN

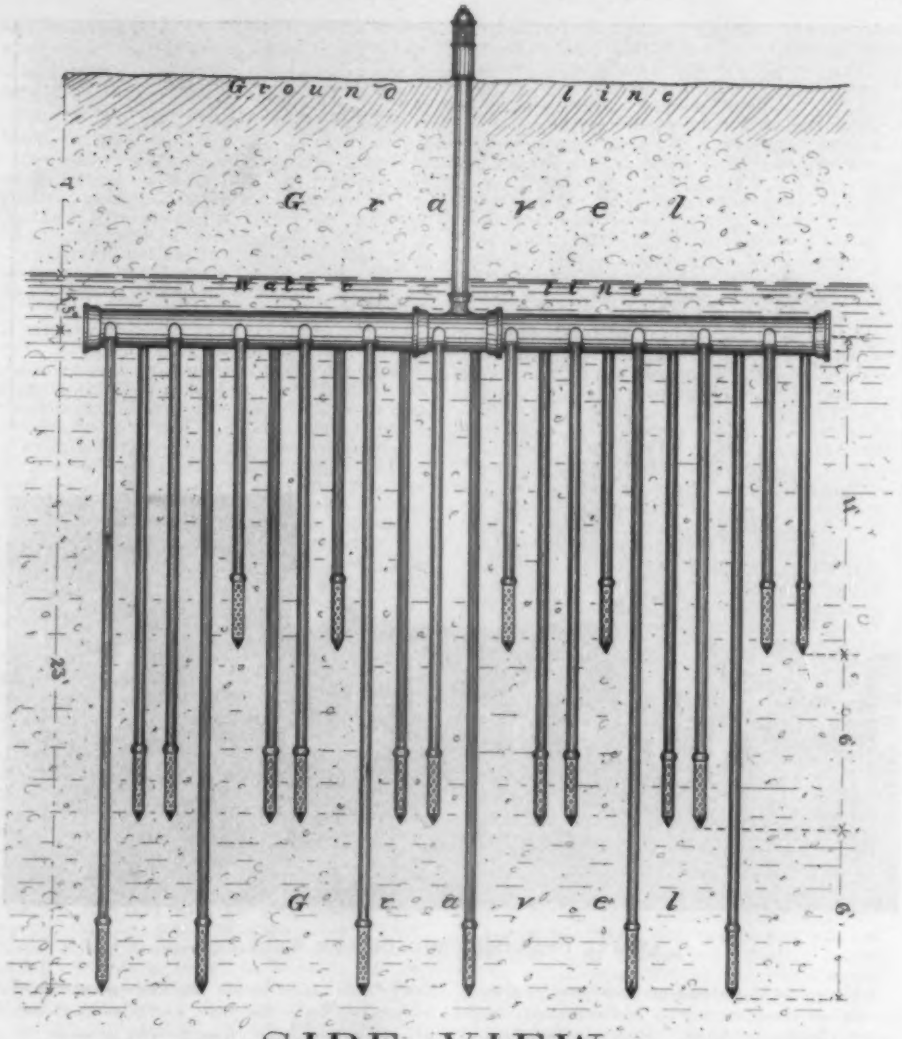
excavation for two feet. This finishes the excavation, and you are ready to proceed in the construction of your well as follows:

Procure two lengths of twelve-inch water pipe and one 12x12x8-inch T. At equal distances along both sides of this pipe and T drill twenty-four holes and cut the standard threads in each for a two-inch pipe. Put the pipe together, caulk securely, plug the ends tightly, and put a plug in the eight-inch opening of the T with the center drilled and standard thread for a five-inch wrought iron pipe. Place a six-inch nipple in each of the two-inch holes in the large pipe and lower the pipe into the water, placing it in the center of the excavation. Screw in the five-inch wrought iron pipe—which must be of sufficient length to reach the surface. An ell must be placed on the upper end of this pipe for use in attaching engine. Now commence driving points. Commence at one end and on both sides of the water main (or reservoir), being particular that the points are driven from four to six feet from the main and in line with the nipple to which they are respectively to be coupled. The points should be put down to irregular depths, none less than ten feet, and from that to eighteen or twenty feet. Drive the points until the top of the pipe with an ell attached will be in line with the nipple on the main. Connect this to the nipple with a union, being particular to make good and tight connections. After two or three points on a side have been put down and connected, any wash that may have worked its way into the excavation may be thrown to this end and the pipes covered as fast as connected. When two or three pipes have been connected, plugs or caps must be placed on the remaining nipples to prevent a flood of water in the pit, and a good-sized pump must be kept constantly at work while connections are being made. The points all driven and connected, throw back the earth and grade up the street. Procure a brass swivel coupling connection reduced to the size of the engine suction hose. This will screw into the five-inch ell on the well, where it will remain permanently and permit the easy attachment of the engine.

It would be well to use a foot or check valve where there is over a twelve or fifteen-foot lift of water. In such case the valve



END VIEW



SIDE VIEW

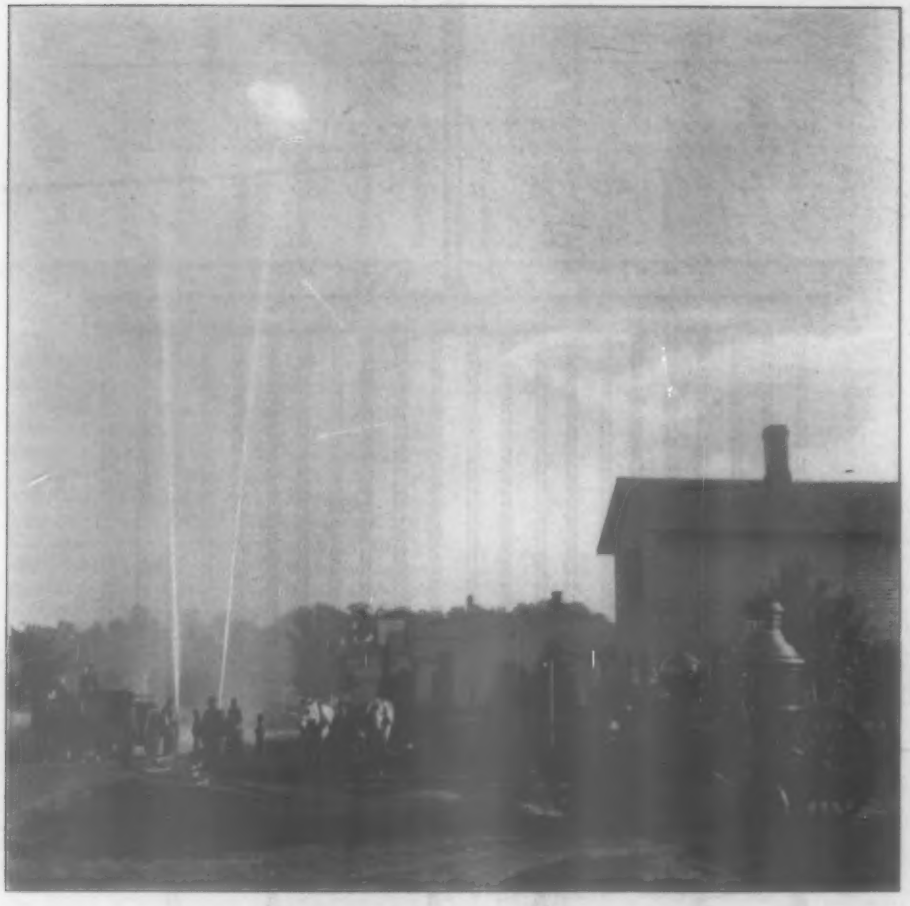
should be placed in the "T" before the pipe is connected and caulked.

The material and labor required in the construction of the well as I have outlined will cost, approximately, as follows:

720 feet 2-inch pipe	$75 00
24 2-inch nipples	3 00
24 2-inch unions	5 50
24 2-inch ells	3 50
24 2-inch points—60 gauge	42 00
1 5-inch ell	50
2 lengths of 12-inch water pipe	25 00
1 12x12x8 cast iron T	12 00
Excavating	50 00
Driving points and connecting pipes..	25 00
Lead, etc., for caulking, and caulking..	5 00
21 feet of 5-inch wrought iron pipe....	8 40
Cutting pipe and threads	25 00
Extra 2-inch couplings	4 00
Back filling and grading	10 00
Brass connection for hydrant	20 00
5-inch foot or check valve	7 50
Pine slabs and sawing	5 00
Total approximate cost	$326 40

This kind of water supply cannot be obtained in all localities. The water line must be within reach of the suction of an engine, and the points, no matter how deep they are driven, must rest in a gravel formation. The placing of the twelve-inch water pipe, to which the points are all connected, two feet below the water line, gives a free flow of water into the pipe under an eighteen-inch head, faster than any steam fire engine can take it out.

Should it be desirable to arrange for connecting two engines to the same well, it would be well to place a reducer at each end of the large pipe, omit the "T" in the center, and place a hydrant at each end. In this case it would be well to increase the number of points to thirty-four or thirty-six. The flow of water into the main pipe is of sufficient volume to prevent the interference of the engines working at the ends.



ENGINE DRAWING FROM DRIVEN WELL.

I have had drawings made of one of these wells as constructed by myself, and they are reproduced here, believing that they will explain the system better than words:

The first illustration represents the general plan; the second the end view, the third the side view and the fourth (a half-tone) an engine at work at this well, throwing two 1⅛-inch streams.

It is claimed by some that fine sand will drift into and settle in the points and eventually clog the pipe, and also that fine gravel will cluster close to and around the fine wire gauze which covers the points, and stop the flow of water. The rapid draught of water from these points keeps them free of fine sand which may find its way in, and the back flow—when pumping ceases—clears the gauze of fine gravel.

THE MANAGEMENT OF SEPTIC TANKS AND BACTERIAL CONTACT BEDS.

The superintendent and chemist of the Manchester, England, sewage works, who directed the long course of experiments upon septic tanks and bacterial contact beds which resulted in the adoption of the system for treating all the sewage of the city, read a paper before the Royal Institute of Public Health at a recent meeting in which he made quite a full statement of the results of his observations upon all steps of the process.

He states that it has now been definitely proved that a thoroughly well purified effluent can be obtained day after day for years, without exception, by purely bacterial methods, in which he includes land treatment by irrigation or downward intermittent filtration; that trade refuse, with

few exceptions, exercises little or no influence on the purity of the effluent; and that a large proportion of the sludge can be dissolved or converted into gas.

Concerning the management of septic tanks he says:

The objects of careful management of septic tanks will be: (1) To dissolve or gasify as much sludge as possible; (2) to obtain a tank effluent in which the matters in solution are easily nitrified; (3) to produce a tank of effluent with little suspended matter; (4) to avoid creating a nuisance. Taking these points in order:

1. Destruction of Sludge in Septic Tank—It must always be remembered that no bacteria have yet been discovered which will consume mineral matter. In all cases, therefore, where road detritus is mixed with the sewage, ample catchpit accommodation should be provided. I have heard of a sewage committee who were so enthusiastic for the septic system, that in spite of the protests of their manager they abolished all catchpits before their septic tanks, saying that if they were to have septic treatment it should be "gradely." Unfortunately their manager's fears were realized, and their tanks rapidly silted up and their enthusiasm for septic treatment is probably on the wane.

Having provided grit chambers, it is necessary that they should be cleared out at frequent intervals, or they cease to be catchpits. The size of catchpit will depend on local conditions, the frequency of cleansing on the weather, most of the grit coming down in storms. If the catchpits are too small all the grit will not be arrested; if too large, sludge, which might otherwise have been bacterialized, will be taken away with the grit. Besides grit it is, in my view, well to screen out bits of wood, rags, etc., as such cellulose material is only very slowly attacked in the septic tank. All such matters, together with the grit, cinders, unburnt coal, etc., which is often present from boiler house drains, should, if possible, be burnt. Wherever it can be done, it will be advantageous to have the town's refuse destructor set up at the sewage works; all catchpit and screen refuse can then be burnt with the town's refuse, and a supply of clinker obtained for bacteria beds. Having removed insoluble substances from the sewage, it will be possible to obtain a higher percentage of destruction in the septic tank.

It will be found that on starting a new septic tank (as in the case of a bacteria bed) that the action begins slowly and gradually arrives at a maximum. It is important, therefore, that the ultimate flow should not be passed through the tank at first, lest sludge should rapidly accumulate before septic action is established. When one septic tank is fully at work, another may easily be started by pumping into it enough sludge from the first to just cover the bottom. I fear it will not be possible for one authority to supply another with septic sludge to inoculate their tanks, as the amount which can conveniently be carried by rail is not enough for the purpose. I once by request sent a barrel of septic sludge to another town, and heard that it had exploded en route.

2. Production of Easily Nitrified Effluent From Septic Tank—It must be emphasized in dealing with this point that by no means the least important function of the septic tank is to so change and break down the soluble constituents of the sewage that these are readily nitrified when put upon bacteria beds. Even if but little reduction in sludge took place this action alone would justify the use of septic tanks. If the flow through the septic tank is at full strength, fresh sewage may find its way on to the beds, and will fail to be purified, for it has been definitely established that beds which have become accustomed to septic sewage will not at once purify fresh sewage, and vice versa. Apparently unaccountable changes in the efficiency of bacteria beds may sometimes be traced to this cause. An increased flow of sewage diluted by rain may be safely put through, as in this case the proportion of organic matter per gallon will be less. It is also quite possible, I believe, to work a septic tank too slowly, and produce a putrid effluent which is actually poisonous to the nitrifying organisms. Possibly some complaints of the nuisance arising from septic tanks may be due to this cause. The exact rate of flow to be adopted will depend on local conditions.

3. Reduction of Suspended Matter in Septic Tank Effluent—The ultimate product of septic action upon sludge, besides the soluble substances above mentioned and the gases methane, carbonic acid, hydrogen and nitrogen, is a very finely divided suspended matter, partly of the nature of humus, partly mineral—e. g., finely divided clay, or sulphide of iron (if iron salts are present in the sewage). This tends to pass away with the effluent, and on to the bacteria beds.

To avoid this result, an attempt has been made in Manchester to remove the fine suspended matter by a special pipe communicating with the grit chamber. By such a device it is hoped that the two insoluble products, the grit on the one hand and the humus on the other, may be taken away from time to time without disturbing the action of the tank. The experiment has not been tried long enough to definitely decide as to its success, but so far there seems no reason why this arrangement should not effect the object in view.

4. Avoidance of Nuisance—A good deal of apprehension has been expressed as to the possibility of nuisance arising from septic tanks, and it is certainly a matter for serious consideration. The residual sludge and grit, if removed as suggested, can be pressed and used for manure or burnt. The silt alone is quite innocuous, and if tipped is rapidly converted into a dry sandy heap. Covering the tank is not a real prevention of the nuisance, unless the gas evolved is collected and burnt. The heat from it may find useful application in drying the garbage, etc., before it is sent to the destructor above mentioned. The value of the gas for this or other purposes will go a long way toward defraying the cost of covering the tanks. In Manchester, Leeds, Accrington and other places, however, there is, singularly, little smell either from the open tank or from the sludge.

With reference to the management of contact beds he says:

The management of contact beds should be directed toward (1) the production of a

pure effluent; (2) the maintenance of capacity; (3) minimum expenditure of labor.

1. Production of a Pure Effluent—(a) Equable Composition of Septic Tank Effluent—One of the chief factors in producing a good contact bed effluent or filtrate is the absence of great variation in the composition of the septic tank effluent. The importance of this has already been indicated when speaking of the management of the septic tank, and will be more easily achieved if manufacturers can be induced to send down their refuse in a steady stream, and not in intermittent flushes. In most cases there is little difficulty in obtaining their co-operation to this end. Successful bacterial treatment of sewage will need certain restrictions to be enforced as to what may or may not enter the sewers, but for the most part these restrictions are already embodied in the Public Health Act Amendment Act, and are not such as to press unduly upon manufacturers. It is often to their advantage that their trade refuse should be under careful supervision, as unsuspected sources of waste are often discovered by this means.

1. (b) Thorough Drainage of Bed—The thorough drainage of a bacteria bed is of the first importance in securing a good effluent. If the water cannot get out the air cannot get in, and the lower parts of the bed rapidly become putrid and the nitrates decrease, perhaps are quite absent. Further reference will be made to drainage when considering the question of capacity. Here it must be emphasized that when the nitrates decrease (and simultaneously there will always as a rule be an increase of nitrates), the beds must be rested. With experience, a modification of the three minutes' oxygen absorption test may be adopted as an index to the efficiency of the bed, which may be put into the hands of a workman to carry out. For a given sewage there is generally a pretty constant relation between the three minutes' oxygen absorption test and the other determinations —ammonia, nitrates, etc. If an acid solution of permanganate of known strength is made up in the laboratory and given to the filter foreman, with a measuring glass, by mixing known quantities of the contact bed effluent and the permanganate solution, he can readily ascertain the character of the effluent by the rapidity with which the permanganate is decolorized.

2. Maintenance of Capacity—It is quite possible for the effluent from the bed to continue excellent in composition, although the bed may be falling off very much in capacity. Careful note must therefore always be made of the time of filling under identical conditions if more accurate methods of measurement are not available, and if it begins to rapidly decrease the bed must be rested. The chief causes of less capacity are the following: (a) Settling together of the material; (b) growth of organisms; (c) impaired drainage; (d) solid matter entering the bed; (e) breaking down of material.

2. (a) Settling Together of Material—This must always occur, and largely accounts for the initial rapid decrease in capacity after the bed had been at work for a short time. It may, indeed, often be necessary to put an additional quantity of material upon the bed to maintain the surface at its original level.

2. (b) Growth of Organisms—This is at once the cause of increased efficiency in the bed and of loss of capacity. On examining the material of a contact bed in active condition every piece of it—clinker, coke, whatever it may be—will be found coated over with a slimy growth. If this is removed it is found to be a stiff jelly, which, after a little drying, can be cut with a knife. Before examining under the microscope it should be treated with dilute acid to remove as much as possible of any hydrated oxide of iron present. It will then be found to consist of masses of bacteria and zoogloea. If placed in a tube containing air and connected with a manometer the jelly will rapidly absorb all the oxygen with production of carbon dioxide. This action will sometimes produce a vacuum equal to 6 inches of mercury. This experiment shows that there is little need to force air into a bed. As a matter of fact there is always a large amount of oxygen to be found in the bottom of a bed in good condition, owing to the interchange of gases which naturally takes place.

The behavior of the bacterial jelly appears to afford a clew to the successful working of bacteria beds. By working them at high speed; i. e., filling them frequently in the day without long periods of rest, the effluent may remain good, but the bacterial growth so rapidly increases that the bed becomes too spongy, and will not allow the water to drain away. Here, too, is the explanation of the fact that, within limits, decrease of capacity is accompanied by increase of efficiency. This decrease of capacity may, however, become so great as to more than outweigh the advantage of increased efficiency. A long period of rest, say one or two weeks, must then be given to the bed. The superfluous bacterial growths will during this time be rapidly consumed, and the capacity of the bed will greatly increase.

Increase of capacity due to this cause is not a merely temporary phenomenon, produced by the drying of the bed. One of the Manchester experimental beds, for instance, sank in capacity during the winter of 1899-1900 to such a low point as 1,480 gallons (the capacity at the beginning of the experiment being 4,200 gallons). At the present time, after fifteen months have elapsed, during which the bed has been in regular use, its capacity under similar conditions of measurement is 2,000 gallons, and it has not yet reached its full summer capacity. This result has been brought about simply by judicious periods of rest. It has been found in the course of experiment that these should not exceed a fortnight at most, as the bed then tends to dry up and the activity of that organism ceases.

These results cause me to think that the policy of pushing the working of the bed to its utmost extent and frequently washing the material, as recommended by Dr. Dunbar of Hamburg, is not really satisfactory. By washing the material the bacterial jelly is removed, and will have to be re-formed before the bed is completely efficient. The time spent in washing, if given to rest, the bed would probably pro-

duce an almost equal rise in capacity, when the initial period of slow working required for regaining the efficiency of the washed bed is taken into account.

2. (c) Impaired Drainage—This matter has already been dealt with in speaking of the causes which tend to deteriorate the effluent. It cannot be too strongly emphasized that every care should be taken in designing the bed to make the drainage as efficient as possible. There should be no opportunity given for the finer particles of the material to work down and block the interstices of drain pipes, etc. The half-acre beds which are being constructed in the Manchester scheme are provided with radial channels all converging to the exit penstock. The channels will be covered with perforated tiles or cement blocks, and over these will be placed at least 1 ft. of large lumps of clinker.

2. (d) Solid Matter Entering Bed—The decrease of capacity owing to solid inorganic matter entering the bed is not necessarily great inasmuch as this material especially if of a sandy nature, has itself a water holding capacity. Its character will depend on the locality—i. e., whether the district is gravelly or clayey, etc. In any case the dry capacity of the bed will not be greatly affected. The danger is that the interstices of the bed may be filled up with clayey mud, which in the wet state will hold up the water and so decrease the wet or working capacity. The loss of capacity will not be affected by resting, and therefore all such solid matter should be retained as far as possible on the surface of the bed, and removed from time to time. It will be found to constitute excellent soil, as it will contain nitrates and phosphates from the sewage, and cabbages and other vegetables will readily grow upon it. A way is open here to allay the fears of agriculturists who view with alarm the impoverishment of the land following upon modern methods of water carriage of sewage.

2. (e) Breaking Down of Material—A more serious cause of loss of capacity than any of the foregoing is the disintegration of the material of the bed. This should be avoided at all costs by using only hard refractory material. When clinkers are used, as will probably be most commonly the case, such only as are hard and well fused should be put into the bed. All shale and ashes must be rejected. As a matter of fact the ordinary weathering which an old cinder tip undergoes, will generally have resulted in the disintegration of all but the harder portions. On screening, therefore, the fines will retain most of the softer material.

To summarize the foregoing: For the successful working of bacteria beds the following method of procedure will be calculated to give the best results. The bed must be worked very slowly at first, in order to allow it to settle down and the bacterial growths to form. In this way there will be less danger of suspended matter finding its way into the body of the bed while the material is still loose and open. The burden should not be increased till analysis reveals the presence of surplus oxygen, either dissolved, or in the form of nitrates, in the effluent. Analysis of the air in the bed may usefully be made from time to time during resting periods.

Also the variations in the capacity should be carefully recorded. If the capacity is found to be rapidly decreasing a period of rest should be allowed. Long periods of rest should be avoided during the winter, as when deprived of the heat of the sewage the activity of the organisms decreases. If necessary the burden on the bed should then be decreased by reducing the number of fillings per day, rather than by giving a long rest at one time.

The suspended matter may be retained on the surface by covering the latter with a layer of finer material not more than three inches in depth. This should not be raked into the bed, but when the amount of suspended matter retained becomes excessive it should be scraped off. This suspended matter may be tipped and made use of for agricultural purposes. By placing the inlet and outlet penstocks as close together as possible the suspended matters will tend to concentrate at this point, and their removal will be facilitated.

After many years, it may, in spite of all precaution, be necessary to wash a portion at any rate, of the material. It should not be difficult to devise a machine by which this may be easily and cheaply done, purified effluent water from a neighboring bed being used for the purpose. This mud so washed out will readily dry, and may be also used for raising vegetables.

3. The Minimum Expenditure of Labor—Unfortunately, data for the actual cost of maintenance of bacteria beds are still limited. Experience with experimental beds, at Manchester and at Oldham, where several acres of beds have been at work for upwards of three years, shows that it should be by no means excessive. Facilities should always be provided in designing beds for the economical removal of material from the surface.

The evidence all points to the conclusion that with careful management, founded on chemical and bacteriological knwledge, the sewage even of large manufacturing towns may be efficiently and economically purified by bacterial methods. Thus we may look forward to a time when the unsightly cinder heaps of our manufacturing districts will be removed to find useful application in purifying the vast volume of their waste liquids. As a consequence large open spaces will once more be set free, which may be utilized for the good of the community. Further, by careful removal of the surface of the beds from time to time, the nitrates and phosphates may be largely recovered from the sewage, and in a perfectly inoffensive form be returned for the service of agriculture. At the same time the standing reproach of our civilization which is presented by the abominable condition of the rivers and streams near our large towns would be removed, and science show itself equal to the demands made by the ever-changing problems of social development.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

The eighth annual convention of the American Society of Municipal Improvements will be held in the auditorium of the Pure Food Company, Niagara Falls, N. Y., Oct. 1, 2, 3 and 4, 1901.

On Tuesday, Oct. 1, at 9 o'clock a. m.,

PRESIDENT ROBERT E. McMATH.

the executive and finance committees will meet at the International hotel. Members and delegates will report to the secretary at the Auditorium for registration, and to receive badges for themselves and guests, 10 a. m. to 12 m. At 12 m. the convention will be called to order and be welcomed to the city of Niagara Falls by the Hon. M. B. Butler, mayor of the city. Response to the mayor's address will be made by the president of the society. After the preliminary proceedings prescribed by the constitution the president, Robert E. McMath of St. Louis, Mo., will address the convention.

At 3 p. m. the convention will hear the reports of the secretary, D. L. Fulton, Allegheny, Pa.; the treasurer, F. J. O'Brien, Oswego, N. Y.; the executive and finance committees, and committees on nominations of officers and next place of meeting will be selected. Reports of special committees on municipal data and statistics, on park development and maintenance, and on standard specifications for brick pavements will then be presented. Amendments of constitution will next be submitted for action.

For Wednesday, Oct. 2, the following papers are listed:

"Management and Control of Public Parks." By Mr. E. C. Lydon, Milwaukee, Wis.

"Local Park System of Wilmington, Delaware." By Theodore A. Leisen, Engineer and Superintendent, Wilmington, Del.

Report of Committee on Street Paving. By Geo. W. Tillson, Assistant Engineer of Streets, Brooklyn, N. Y., Chairman.

"Recent Experience With Wood Pavements." By B. T. Wheeler, Superintendent of Streets, Boston, Mass.

"The Possibilities of Coal Tar in Bituminous Pavements." By Mr. Fred J. Warren, Boston, Mass.

"Wooden Pavements at Home and Abroad." By F. A. Kummer, General Manager U. S. Wood Preserving Co., Boston, Mass.

"Pavement Guarantees." By Geo. W. Tillson, Assistant Engineer Streets, Brooklyn, N. Y.

"Relative Merits of Portland and Natural Cements in Pavement Foundation." By C. H. Rust, City Engineer, Toronto, Ontario.

"Tar Macadam Roads in Hamilton, Ontario." By Mr. Wingate, City Engineer, Hamilton, Ontario.

"Asphalt and Its Compounds in Nature. Sources of Supply, Analyses, Principal Uses in Engineering." By Maj. J. W. Howard, C. E.

Report of Committee on Electric Street Lighting.

Report of Committee on Sewerage and

VICE-PRESIDENT E. A. FISHER.

Sanitation. Prof. A. N. Talbot, Urbana, Ill., Chairman.

"The Cost of Sewer Construction." By Emmett Steele, City Engineer, Burlington, Ia.

"New Sewage Purification Plant of Madi-

son." By Prof. F. E. Turneaure, City Engineer, Madison, Wis.

"State Legislation and Municipal Sanitation." By Prof. Olin H. Landreth, Consulting Engineer, New York State Board of Health, Schenectady, N. Y.

"The Water Meter as a Sanitary Agent." By M. N. Baker, Assistant Editor Engineering News, New York.

"Engineering Phases of the Work of Municipal Boards of Health." By Marshall O. Leighton, Health Inspector, Montclair, N. J.

Report of Committee on Water Works and Water Supply. G. Bouscaren, Chief Engineer of Water Works Commission, Cincinnati, O., Chairman.

On session of Thursday, Oct. 3, will be heard:

Report of Committee on Taxation and Assessment. August Herrmann, President Water Commission, Cincinnati, O., Chairman.

Report of Committee on Disposition of Garbage and City Cleaning. John Jones, Superintendent of Streets, Toronto, Ont., Chairman.

"The Utilization of Garbage in the Production of Steam." By Edward B. Ellicott, City Electrician, Chicago, Ill. By J. C. Mundy, General Superintendent, Newark, N. J. By John H. Emigh, City Engineer, North Adams, Mass.

Report of Committee on City Government and Legislation. W. K. Eldridge, Lafayette, Ind., Chairman.

Each subject will be discussed after the presentation of the papers accompanying the committee report.

The program is unusually good even for this society, which has a reputation for

TREASURER F. J. O'BRIEN.

valuable and interesting practical discussions of the live questions in municipal improvement. Every municipal official will find himself fully repaid for the time and money expended in attending the meeting.

MUNICIPAL MATTERS IN COURT.

[Prepared for MUNICIPAL ENGINEERING MAGAZINE by Andrews & Murdoch.]

Measure of Damages to Abutting Property After Change of Grade.—The damage to abutting property resulting from the lawful changing of the grade of a city street may be determined by deducting the value of the premises after the change from its value before. In re Grade Crossing Commissioners of City of Buffalo, 71 N. Y. Supp. 674.

Completeness of Water System—The fact that a water works system supplying the complainant town gets its water from a reservoir which also supplies another town does not render the system incomplete, so as to preclude a purchase by the town of the plant, the supply being ample for both towns. Town of Bristol vs. Bristol & W. Water Works, 49 At. Rep. (R. I.) 974.

Ordinary Road or City Street—Where municipal authorities do nothing more than keep a highway in ordinary repair, there is no change of it from an ordinary road to a city street, so as to relieve abutting property from liability for the cost of a subsequent paving as an original paving. City of Harrisburg vs. Funk, 49 At. Rep. (Pa.) 992.

Notice to Repair Sidwalk—An order of the common council to a property-owner to put sidewalks "in good and sufficient repair, free from defects, and safe and convenient for travel," is insufficient, because of uncertainty as to the manner in which the repairs were to be made. State vs. Richards, 49 At. Rep. (Conn.) 858.

Implements in Use by City—A city may lawfully use any proper implement operated by steam for the purpose of constructing or repairing its streets, and, in the absence of negligence in its management, is not liable for damages occasioned by a horse becoming frightened thereat. McMulkin vs. City of Chicago, 92 Ill. App. 331.

Municipal Improvements—A lot holder who consents to a change of grade of a sidewalk in front of part of her property, and who stands by without objection, while the city authorities do extensive work and

expend money thereon and on the sidewalk of adjoining owners, will not be allowed an injunction to restrain the completion of the work on the remaining portion of the sidewalk. Scharr et al. vs. City of Camden et al., 49 At. Rep. (N. J.) 817.

Irregularities in Establishment of Grade.—Where a city council has attempted to establish the grade of a street, mere irregularities, or even invalidity, in the proceedings, not amounting to a want of jurisdiction, would not affect its power to subsequently improve the street according to such grade or afford ground for an injunction by a property-owner to restrain the collection of an assessment for such improvement after the work had been completed. Wingate et al. vs. City of Astoria et al. 65 Pac. Rep. (Or.) 982.

Ratification of Defective Contract.—Where a borough has authority to enter into a contract by which to license certain individuals to supply the citizens of the borough with gas, on condition that gas shall be furnished to street lamps free, and the resolution authorizing such a contract is defective, because not signed by the burgess, the borough has power by a subsequent ratification to make valid the contract. Borough of Sandy Lake vs. Sandy Lake and S. Gas company, 16 Pa. Super. Ct. 234.

Grade Held Established.—Acts 1869, c. 906, authorized certain towns to regulate grades and improve a certain highway, and commissioners were named therein, who graded the road. Thereafter a portion of such road became a street in the city of Mt. Vernon. Held to create and establish a grade of the street which would require proceedings for the change thereof to be brought under provisions of city charter authorizing and prescribing the procedure for a change of grade, and not under sections authorizing the grading of city streets. Archer vs. City of Mt. Vernon, 71 N. Y. Supp. 571.

Power of Council to Contract.—Under Rev. St. Sec. 1691, providing that a city council should not enter into any contract not going into operation during the term for which all its members are elected, does not apply to the full performance of every part of a contract to lay pipes and furnish gas, where such performance would require much time, so as to render the contract void. City of Chillicothe vs. Logan Natural Gas and Fuel company, 8 Ohio N. P. 88, 11 Ohio S. & C. P. Dec. 24.

Suit Against Contractor After Acceptance.—In an action brought by a town against its contractor for the construction of a water works and electric light plant to be reimbursed for moneys expended for repairs to the plant made subsequently to acceptance by and delivery to the town after the work had been subjected to contract tests, and the engineer agreed upon by the parties to supervise and test the work had certified that the work was complete, in accordance with the contract, the town carries the onus of establishing clearly that the expenditures were for repairs for which the contractor was liable under his contract. Consolidated Engineering company, limited, et al., vs. Town of Crowley (Buck et al., interveners), 30 So. Rep. (La.) 222.

Secret Bid.—The director of public works of Philadelphia, after the expiration of the time fixed by advertisement for receiving sealed proposals for the performance of a municipal contract, wrote to one of the bidders a letter requesting information as to what work was included in the bid, the language of which was so couched as to suggest to a man of ordinary business intelligence that he would lose in the competition unless important additions were made to his bid, to which the bidder replied by letter that his bid included, with certain specified exceptions, an undertaking to do all work necessary to complete the contract for a lump sum, which was less than the price bid by competitors; and the director thereafter awarded such bidder the contract. Held that, as the contract was awarded, not on the bid submitted in accordance with the advertisement, but on the offer to complete work for the lump sum contained in the bidder's reply to the director's letter, which was in effect a secret bid, put in after the date fixed by the advertisement for the closing of bids, the award was unauthorized and void, and a court of equity would restrain the mayor and director from executing the contract pursuant thereto on a bill filed by a taxpayer. Ryan vs. Ashbridge, 10 Pa. Dist. R. 153.

CURRENT INFORMATION.

Asphalt Paving Specifications.

The city of Marion, Ia., has let some contracts for asphalt paving under specifications which, if followed strictly, should insure good pavements.

The foundation is of Portland cement concrete, 5 inches thick, in proportions of 1 part cement, 3 parts sand and 7 parts crushed stone. Neat cement must have a tensile strength of 400 pounds in 7 days; mortar, 1 to 3, 175 pounds in 7 days, with 15 per cent. increase in 28 days. The paving is laid "with such asphalts and in such a manner as will insure a topping that will not require repairs of any kind by the city of Marion for the first seven years, at the

end of which period there shall be no settlement or irregularities causing a variation in the surface of ⅝ inch or over, measured with the length of a 4-foot straight edge, or any crack of ¼ inch or over in width, or which shows disintegration from any cause whatever." The kind of asphalt was "any asphalt which in the mind of the city council and the engineer is as good or better than Trinidad pitch lake, Bermudez or California Alcatraz. The formula for the asphalt surface was required to accompany the bid, to be treated as a part of the specification and contract, but a special formula was also included in the specifications, which, however, could be modified as approved by the committee and engineer.

Combined curb and gutter was constructed of 1 part Portland cement and 4 parts river gravel, faced with ½-inch on gutter and ⅝-inch on curb of mortar made of 1 part of the same cement and 1½ parts of clean screened river sand.

Asphalt Inquiries from Milwaukee.

The replies received by Mayor Rose of Milwaukee, Wis., regarding the relative merits of Pitch lake and land asphalts, using his own expression, "lead to confusion rather than an enlightened conclusion." Of twenty-one cities to which the questions were addressed, answers were received from twelve. Of these cities Joliet, Ill., replied through its city engineer:

I believe that the merits or demerits of an asphalt pavement are to a large extent independent of the source of the asphalt, but depend more upon obtaining a mixture having proper proportions of asphaltine and petroline in the bitumen, and also upon the use of a sand uniformly graded as to size from very fine to coarse. I believe another very important point is, the mixing and workmanship, as well as good judgment to be used in preparing a mixture to be used in any certain street, according to the class of traffic, etc.

The reply from Cedar Rapids, Ia., said:

After three years of examination and investigation, I was led to believe there is practically no difference in the so-called land asphalt and the pitch lake asphalt. On page 210 of Consul Pierce's report (United States consul's reports, No. 145, October, 1892) you will find that Mr. Barber claimed the land asphalt as good as the lake asphalt.

Land asphalts have never been excluded at Syracuse, N. Y. That city has nearly twenty-five miles of asphalt paving, of which about two-thirds is land asphalt, and some of this has been laid eight years. The city engineer says that "after ten years' experience in connection with city work," he can see "no difference" between the land and the lake asphalts.

The city engineer of Albany, N. Y., says:

Land asphalt debarred previous to 1900 then changed to admit it. The principal test for either lake or land asphalt is the amount of bitumen contained in the wearing surface, which should be about 12 per cent.

I believe that the land asphalt, if properly refined and laid, makes just as good a pavement as the lake asphalt. Two streets, Madison and Watervliet-aves., laid in 1891 with lake asphalt, are now in terrible condition and require complete resurfacing. Contract has been let to Warner & Quinlan for resurfacing with land asphalt for $1.25 per square yard. Asphalt trust bid $2.04. We also have a public market and several streets paved with lake asphalt which are in excellent condition. Can only attribute the difference to proportions of mixture or methods of laying.

The former city engineer debarred land asphalt for reasons which I do not know—unless the general opinion that lake was better than land asphalt.

No difference (between lake and land asphalt) where it is intention of contractor to lay a good pavement.

The principal reason for allowing the use of land asphalt now is the belief that it is as good as lake asphalt and does not cost near as much, owing to the price being kept up on lake asphalt by the asphalt trust.

The replies from the other cities showed the following:

Philadelphia—Nothing but Pitch lake asphalt is admitted. Land asphalt never admitted, as reports from where used show it has no life.

St. Louis—Land asphalt never admitted, but city has laid over twelve miles of Pitch lake asphalt.

Boston—City has laid nearly fifteen miles of asphalt paving; has admitted land asphalt within the last two years, with the result that it has been receiving bids for land asphalt 20 cents a square yard cheaper than it has been paying for Pitch lake. No information is given as to the relative merits.

Baltimore—City has used Pitch lake asphalt exclusively, but no reason is given for this.

Buffalo—Both land and lake asphalts are permitted.

Minneapolis—City has never used any land asphalt.

Washington—Both asphalts admitted. This year land asphalt bids were lower, and after careful investigation the contracts were awarded for land asphalt.

Denver—City has but one pavement of land asphalt and that is a failure.

Aurora, Ill.—City has laid one mile each of Pitch lake and land asphalt, which has been down seven months.

Providence—Lake asphalt considered best; did not care to experiment.

Cleveland—City has admitted land asphalt, but the city engineer believes that "rock" asphalt from the Jura mountains, Switzerland, is the best, and Pitch lake next. He

adds that a long-time guaranty is the best method to obtain good work.

New Orleans—City has twenty-five miles of asphalt paving. Up to 1895 land and other asphalts were excluded. City council then ordered the city engineer to make a complete investigation, with the result that land and other asphalts were admitted. The city engineer says that "after personal experience of five years as principal city engineer, and the study of all available literature on the subject, I can see no difference between Pitch lake and hard asphalts."

St. Paul—Land asphalt was admitted recently.

Requirements of Inspectors.

At the trial of Paving Inspectors Heaney and Rogers, at Chicago Sept. 10, Joseph Downey, formerly commissioner of public works and building commissioner, said: "The city ought to have paving inspectors who know what good cement is. Shoemakers, tailors and clerks can't be expected to know these things." He also stated that the city requirements for constructing foundations for paving are not correct from a mechanical standpoint. The inspectors are charged with having inspected indifferently and negligently Jefferson-st., between Madison and Van Buren.

Los Angeles Purchases Its Water Works.

Los Angeles has voted, 6,284 to 1,267, to issue $2,000,000 in bonds for the purchase of its water works in accordance with the agreement made between the council and the water company in July.

Oswego Water Works Trouble.

The city government and the people of Oswego, N. Y., are having trouble over the question of a new water system and the matter has beene taken into the courts. No decision has yet been given. Oswego has a fifteen-year contract with the local water company and the agreement will expire within two years. The people have long claimed that the water furnished them is impure and a strong movement for municipal ownership or pure water has been started. This summer the common council made arrangements for entering into a new contract with the old company, although the old contract has two years to run. The proposed new agreement provides for filtering the water and contains four options for municipal ownership, should the people decide to buy. An attorney representing the tax-payers secured a temporary injunction restraining the council from acting. The attorney served the papers during a session of the council, and there is a dispute as to whether the papers were served before the contract was let the councilmen claiming that the attornewy was too late. The mayor, it appears, has not yet signed the contract. It is said that Oswego's bonded indebtedness will prevent municipal ownership.

Ordinance on Electrolysis in Norfolk, Va.

The prevention of electrolysis is provided for in an ordinance which has been submitted to the city council of Norfolk, Va., by a joint committee of the two branches of the council and the board of electric control. The ordinance provides that on or before Feb. 1, 1892, all companies using electric current shall "provide and put in use the latest designs and most effective appliances to control and effectively retain such currents in their proper channels, and on their own wires, tracks and other works so as to prevent injury to pipes and other structures belonging to the city of Norfolk, in the streets and alleys or other parts of said city, and repair and renew said mains and appliances, or from time to time change and improve the same as may be necessary to accomplish said purpose, all at its or their charges and expense, and at its or their own risk, selecting and adopting such means and appliances as shall prevent injury to pipes and other structures belonging to said city as aforesaid."

Provision is also made in the ordinance for payment by the street railway company for all damages to water mains heretofore caused by electrolysis, the same to be determined by an electrical survey, supplemented, if necessary, by arbitration.

Washington Traction Company Cannot Sell Electric Power.

In an opinion rendered to the District Commissioners, Washington, D. C., A. B. Duvall, attorney for the District, holds that the Capital Traction Company cannot sell its electric power for lighting purposes. "The Capital Traction Company is a railroad company," says Attorney Duvall, "and I do not find anywhere that it may sell its electric power; its authorization is to use this as the motive power of its railroad system and in connection with the appurtenances and incidents thereto."

Legality of Incorporation of Many Illinois Towns in Question.

A number of towns and villages in Illinois have never been lawfully incorporated, according to Secretary of State Rose.

In making a comparison between the census bulletin and the records of the state he found eighty-two towns and villages in the census returns which are not found on his records. Almost all of these are exercising the privileges of incorporated municipalities wthout havng complied with the statutory requirement that they file a copy of the proceedings relative to their

proceedings with the secretary of state. Besides these villages fifteen other cities and villages are found on the records as having been incorporated under the general law of 1872, but which are not mentioned in the census returns of last year. In most instances these have been annexed to other cities. There is still another class comprising thirty-four towns, many of which are the subjects of doubt and uncertainty. These thirty-four towns and villages are shown by the secretary's record to be incorporated under special acts prior to 1872, but they have not since been incorporated under the general law. Some of them are known to exist as working municipalities, but many of them are not mentioned in the census returns, nor do they appear in the postoffice directory. In most instances the incorporation proceedings were, as a rule, considered in a proper manner up to the point of filing a certified copy of such proceedings with the recorder of deeds and the secretary of state, and in a few cases the papers were filed with the recorder of deeds, but none were sent to Springfield. Village authorities, however, seem to have been careless about these records from the first.

Not Applicable to the United States.

A plan providing for the superannuation of civic employes is being formulated in Montreal, Canada. A by-law has been drafted which provides for old employes who have been obliged to quit work at an age when they were unable to do anything else and were left almost penniless. A sliding scale is suggested, according to age. All will have to contribute something, but those who are old will have to pay more liberally than those who are young.

Municipal Play Ground in Washington

A municipal playground, to be operated in conjunction with the schools of Washington, D. C., is proposed by Ray R. Riordan, who will submit a plan to the district commissioners. An appropriation of more than $14,000 will be required to furnish the playground with club house, ball ground, and apparatus for athletic sport and development.

Expansion of Cement Walks.

Regarding the expansion of cement walks a subscriber, Mr. Charles D. Shearer of Honolulu, Hawaiian Islands, states that the action of heat upon cement walks is something with which to contend at all times in the tropical climate islands. After twelve in the tropical climate of the islands. After twelve years' experience in California and Hawaii he says that laying the walk in alternate sections, at right angles with the curb, and tar paper in joints will relieve any danger of buckling in any climate.

An Eastern Forest Reserve for National Park.

A preliminary report has been submitted by Secretary of Agriculture Wilson on the forests of the Southern Appalachian region, who says:

The movement for the purchase and control of a large area of forest land in the East by the government has chiefly contemplated a national park. The idea of a national park is conservation, not use; that of a forest reserve, conservation by use. I have therefore to recommend a forest reserve instead of a park. It is fully shown by the investigation that such a reserve would be self-supporting from the sale of timber under wisely directed conservative forestry.

Letting of Contracts for Louisiana Purchase Exposition.

The letting of contracts for $4,000,000 worth of main buildings for the great St. Louis exposition will begin about Dec. 1. It will be followed by contracts for $4,000,000 worth of work on the grounds and other buildings costing about $3,000,000 additional. Isaac S. Taylor is the director of construction and maintenance.

A Century of Civil Engineering.

We are indebted to J. James R. Croes, president of the American Society of Civil Engineers, for a copy of his address at the annual convention of the society at Niagara Falls in June, entitled "A Century of Civil Engineering."

The culmination of the century's progress is vividly stated in the following extract:

The most thorough exemplar of the condition of civil engineering at the beginning of the twentieth century is the modern office building in a great city. One hundred years ago, the man of enterprise who resided fifty miles from a large city and wished to consult an engineer regarding a project for a new canal, arose before daylight, struck a spark from his flint and steel, which falling on a scrap of tinder was blown by him into flame and from that a tallow dip was lighted. In the same primitive manner, the wood fire was kindled on the kitchen hearth and his breakfast was cooked in a pot and kettle suspended from the iron crane in the fireplace. Entering the cumbrous stage coach, hung on leather springs, which passed his door, he was driven over muddy roads, crossing the narrow streams on wooden trestle bridges and the navigable rivers on a ferry boat, the paddle wheels of which were turned by a mule on a treadmill. At last he was landed in the city where he walked through dirty streets paved with

cobblestones until he reached his destination, a plain three-story brick building founded on sand, with a damp cellar and a cesspool in the back yard. Entering a dark hall he climbed a wooden staircase and was ushered into a neat room, rag-carpeted, warmed by a wood fire on the open hearth and lighted by a sperm oil lamp with one wick, for it was dark by this time. No wonder that before proceeding to business he was glad to take a good stiff noggin of New England rum.

Today, his grandson, living at the old homestead, while comfortably eating his breakfast, which has been cooked over a gas range, reads in his morning paper that the high dam of the irrigation reservoir in Arizona, in which he is interested, sprang a leak the day before, and he telegraphs to his engineer in the city that he will meet him at his office at noon. Then, striking a match, he lights the lamp of his automobile, which is fed by petroleum brought 200 miles underground in pipes from the wells, rolls over macadamized roads to the railroad station, where he boards a luxuriously appointed train, by which he is carried above all highways, through tunnels, under rivers, or across them on long-span steel bridges, and in an hour is deposited in the heart of the city, where he has his choice of proceeding to his destination through clean and asphalt-paved streets in electric surface cars at nine miles an hour, elevated steam cars at twelve miles an hour, or through well-lighted and ventilated tunnels at fifteen miles an hour. Reaching the spot his grandfather had visited, he finds there a huge and highly decorated building, twenty or more stories high. Founded on the primeval rock, far below the surface of the natural ground, the superjacent strata of compressible material having been penetrated by caissons of sheet metal sunk by the use of air, compressed by powerful pumps driven by steam or electricity generated at a power station half a mile or more away, and on these caissons filled with a manufactured rock such as the ordinary processes of nature would require millions of years to produce, there is erected a cage of steel, the composition of which has been specified, and the form and mode of construction of which have been so computed that the force of the elements cannot overthrow the structure or even cause it to sway perceptibly. Towering above the courts of law, the temples of religion and the palaces of the arts, the meshes of this mighty cage are filled with products of the earth, the mine and the forest, transformed so as to be strong and light and incombustible, and all interwoven with pipes and wires, each in its proper place and noted on the plans. In one set of these pipes there is pure water, which has been collected from a mountain area of igneous geological formation, depopulated and free from swamps, on which a record of the daily rainfall is kept, and in which impounding reservoirs have been constructed by masonry dams across its valleys. From these reservoirs, the water, after filtration through clean sand, is conveyed thirty or forty miles through steel or masonry conduits to covered reservoirs whence it is drawn as needed through cast-iron pipes to the building where it is to be used, and there distributed to all parts of it, chilled nearly to the freezing point through one system of pipes or heated nearly to the boiling point through another system. Another set of pipes carries steam which, passing through radiators, keeps the temperature of the air throughout the building at the proper standard for comfort. Sanitary conveniences are provided everywhere, and all wastes are consumed within the building by the surplus heat generated, leaving only ashes to be removed. Wires convey electric currents to all points, so that the occupant of a room, sitting at his desk, can by the touch of a button ventilate his apartment, illuminate it, call a messenger, be kept informed of every fluctuation in the markets, converse with anybody who is not "busy" within 40 miles of where he sits and if entirely "up to date" can require his autograph and portrait to be reproduced before his eyes for identification. He dictates his correspondence and his memoranda, and "takes his pen in hand" only to sign his name. He need not leave his seat except to consult the photograph hanging on the wall, which shows to him the latest condition of the mine, the railroad, the arid lands irrigated, the swamps reclaimed, the bridge in progress, the steamship, the water-works, the tunnel or the railroad, the dam, the filter or the sewage works, the town, the machine, the power plant or the manufacturing establishment in which he is most interested.

Entering the brilliantly lighted hallway of this building, the air of which is kept in circulation by the plunging up and down of half a dozen elevators, the visitor is lifted at a speed of 500 ft. a minute, past floor after floor, crowded with the offices of financiers, contractors, promoters of traffic and of trade, lawyers, chemists, contractors, manufacturers, to the headquarters of the controlling genius of the whole organism, the civil engineer. For he it is to whom all the members of this microcosm must apply for aid and advice in the successful operation of their respective occupations. It is not his to mechanically transform elements into matter, or matter into other forms, or to show how energy may be produced, but to direct the application of energy to the various forms of mat-

ter, original or produced, in such way as to bring about the most satisfactory results in the most speedy and economical manner.

The Union of Canadian Municipalities.

At the first annual convention of the mayors at Toronto, Ont., Aug. 29, an organization was formed which will be known as the Union of Canadian Municipalities. Resolutions were passed providing:

That municipalities should have full and exclusive control of their streets, and that no legislation should be passed infringing on such control unless the same be subject to consent of the municipality concerned; that the members of the union will resolutely resist each and every invasion of these rights, and that the executive committee be charged with the duty of assisting to prevent such invasions of the rights of any municipality.

That all legislation under which properties of certain corporations are to be assessed as scrap iron, should be decisively repealed.

That it is contrary to equity and to wise public policy and of doubtful legality, that governments should exempt their properties and the incomes of those in their employ from municipal taxation, and that the executive committee be authorized to consider the best means of giving effect to this resolution.

Officers were elected as follows: President, Mayor Howland, Toronto. Provincial vice-presidents—Ontario, Mayor Morris, Ottawa; Mayor Reid, Owen Sound; Quebec, Mayor Lighthall, Westmount; Councilor Knowles, Westmount; Nova Scotia, Mayor Hamilton, Halifax; New Brunswick, Alderman Macrae, St. John; Manitoba, Mayor Arbuthnot, Winnipeg.

Meeting of the International Association of Municipal Electricians.

The sixth annual meeting of the International Association of Municipal Electricians opened in the convention hall of the International Hotel, Niagara Falls, at 2 p. m., Sept. 2. Mr. Morris W. Mead of Pittsburg, Pa., presided.

After the usual addresses of welcome W. M. Petty, superintendent of telegraph of the Rutherford (N. J.) Fire Department, read a paper on "The Protection of Fire and Police Telegraph Wires from High Tension Currents and Lightning." The paper will be printed in this magazine later.

On Tuesday, Sept. 3, an address was delivered by Mr. H. W. Pope on "Telephones as Applied to Municipal Affairs." A paper was also presented by Mr. E. F. Schurig of Omaha entitled "Municipal Control vs. Municipal Ownership," which will appear next month.

At the Wednesday morning session a paper was read by Mr. P. H. Alexander of New York on "Magnetic Car Brakes."

New officers were elected as follows: President, A. S. Hatch, Detroit; vice-presidents, W. M. Petty, Rutherford, N. J.; A. G. Ferrand, Atlantic City; William Crane, Erie, Pa.; W. A. Barnes, Bridgeport, Conn.; secretary, E. P. Foster, Corning, N. Y.; treasurer, Adam Bosch, Newark, N. J.

Executive Committee—W. H. Thompson, chairman, Richmond,, Va.; M. W. Mead, Pittsburg; William Brophy, Boston; J. W. Aldon, Wilmington, Del.; F. G. Boyd, Baltimore, Md.; F. C. Mason, Brooklyn; W. Y. Ellett, Elmira; G. F. MacDonald, Ottawa; M. G. Campbell, Grand Rapids, Mich.

Finance Committee—M. J. Donohue, Niagara Falls, chairman; J. F. Zeluff, Paterson, N. J.; Jerry Murphy, Cleveland; Elmer Loomis, Allegheny; Ion Simon, jr., Charleston, S. C.

Richmond, Va., was selected as the place of the next annual meeting.

Technical Meetings.

The Central States Water Works Association will hold its fifth annual convention at Evansville, Ind., Oct. 1-3. Fred Baker, Evansville, is president of the local committee in charge of exhibits.

The twentieth annual meeting of the American Street Railway Association will be held in Madison Square Garden, New York City, Oct. 9, 10 and 11. Papers will be presented as follows:

(1) "Street Railways—a Review of the Past and a Forecast of the Future;" (2) "The Adoption of Electric Signals on Suburban and Interurban Railways, Single or Double Track, and Their Economy of Operation;" (3) "The Value of Storage Batteries as Auxiliaries to Power Plants;" (4) "The Public, the Operator and the Company;" (5) "The Best Manner and Mode of Conducting the Return Circuit to the Power House;" (6) "The American Street Railway Association—the Purposes of Its Organization and the Benefits Accruing to Investors In, and Operators of Street Railway Properties by Membership Therein;" (7) "The Economies Resulting from the Use of Four Motors Instead of Two on Double Motor Equipments;" (8) "The Best Form of Car for City Service—a Consideration of the Various Types of Car as to Size of Car and Arrangement of Seats, Including Best Types of Brakes and Wheels;" (9) "Practical Results Obtained from Three-Phase Transmission and Rotary Transformers or Motor Generators in Transmitting Power on Railway lines;" (10) "Relations of Interurban and City Railways;" (11) "The Modern Power House, Including the Use of Cooling Towers for Condensing Purposes." Walton H. Homes, president,

Kansas City, Mo.; T. C. Penington, secretary, Chicago, Ill.

The ninth annual convention of the Street Railway Association of the State of New York opened in Rochester, Sept. 10. The papers presented were as follows: "Track Bonding," Alfred Green of Rochester Railway Company; "Steam Railroad Crossing," T. J. Nicholl, vice-president and general manager Rochester Railway Company; "Storage Batteries," C. E. Roehl, electrical engineer power house, Brooklyn Rapid Transit Company; "The Use of Series Boosters in Connection with Street Railroads," William J. Davis, Jr., General Electric Company, Schenectady, N. Y.; "Transportation System, Rochester Railway Company," C. A. Ingle, Rochester Railway Company, Rochester, N. Y.; "General Track Construction," E. H. Parke, engineer maintenance of way, Brooklyn Rapid Transit Company, Brooklyn, N. Y.; "Third Rail Interurban Railways," Maurice Hoopes, electrical engineer for J. G. White & Co., New York City; "Benefit Associations," G. G. Moorehouse, Rochester Railway Company, Rochester, N. Y.; "Accidents," Mr. Patterson, Metropolitan Street Railway Company, New York.

The Tennessee Good Roads Convention will hold its first annual convention in Nashville, Oct. 8.

The directors of the Michigan Engineering Society met at Lansing, Mich., Sept. 18, and elected officers for the ensuing year, as follows: President, Wm. B. Sears, Saginaw, Mich.; vice-president, Prof. M. E. Cooley, Ann Arbor, Mich.; directors, Prof. J. B. Davis, Ann Arbor; H. E. Riggs, Toledo, O.; Dorr Skeels, Grand Rapids; secretary and treasurer, Frank Hodgman, Climax, Mich.

The next annual meeting of the Ohio Electrical Light Association will be held in Columbus in October, 1902. Officers for the ensuing year were elected as follows: President, W. F. White, Cincinnati; vice-president, E. H. McKnight, Middletown; secretary-treasurer, J. H. Perkins.

The National League Improvement Association, at its recent meeting in Buffalo, decided to change its name to the National Civic Improvement League. Some of the papers presented were "The Influence of Neighborhood Improvement Associations in the Embellishment of Cities," Chas. M. Loring; "Better Highways," H. S. Earle; "Relation of the Pan-American Exposition to the Public Beauty Movement," William Scott. Officers were elected as follows: President, Charles Zeublin, University of Chicago; first vice-president, Edwin L. Sherrin, Dayton; second vice-president, Mrs. Condlin Hamlin, St. Paul; third vice-president, Henry Metcalf, Cold Springs, N. Y.; treasurer, W. H. Moulton, Cleveland; corresponding secretary, E. G. Routzahn, Dayton; recording secretary, Mrs. Charles L. Robinson, Rochester; organizer, Miss Jessie L. Good, Springfield, O.

The American Institute of Architects will hold its thirty-fifth annual convention at Buffalo Oct. 3, 4 and 5. Thursday morning will be taken up with reports of committees. The afternoon session will discuss papers and committee reports on legislative questions. Friday morning will be devoted to a study of exposition making with papers by experts on Omaha, Buffalo and other expositions. The evenings and Saturday will be devoted to the exposition and Niagara Falls excursions.

New Publications.

American Street Railway Investments, a supplement to the Street Railway Journal. Published annually for the use of bankers, brokers, capitalists, investors and street railway companies; 288 pages, $5. The Street Railway Publishing company, 120 Liberty-st., New York.

The book opens with a review of the year, ending with its date of publication, April 1, including a comparison of the gross receipts of various companies for the years 1899 and 1900, and proceeds promptly to the statements concerning city and interurban railways, which are arranged alphabetically by cities, the interurban roads appearing under the city in which the general office is situated. The history of each company is stated, giving date of incorporation, length of charter and franchise and character of same, companies absorbed, capital stock, funded debt, comparative financial statements of results of operation, balance sheet, statement of amount of plant and equipment, names of officers and directors, location of offices, references to sources of information regarding details of former financial operations, operation and construction.

A valuable feature of the book is the series of sketch maps of cities and districts, showing the street railway lines constructed and in contemplation.

To any one interested in financial operations of such companies the book must be of great value, and the lists of executive officers, locations of offices and reports of operations will be very convenient for those having railway supplies for sale. Much of the value of such a publication is in its accuracy and its freshness. The detail with which the information is given is in itself a safe indication of its accuracy, and the date of information given for each company is seldom more than four months earlier than the date of issuing the volume.

Water Works For Small Cities and Towns, by John Goodell. The Engineering Record series, 286 pages, $2. The Engineering Record, New York.

Mr. Goodell has gathered into book form a number of articles originally prepared to

answer questions from those seeking information upon the details of design and construction of small water works. It gives statements of the practice of engineers, gathered from articles, books and observation, and includes both technical details and more general discussions suited to the attainments of municipal officials and officers in water companies who are not familiar with technical details and methods of thought. It has the faults of arrangement and of crudeness of statement due to its method of preparation, but they do not detract from its solid value as a collection into one book of details of good practice which are otherwise not attainable without long search through engineering periodicals, the proceedings of societies and monographs by engineers.

Sullivan's New Hydraulics, consisting of new hydraulic formulas and the rational law of variation of coefficients of flow and resistance to flow in all classes of rivers, canals, flumes, aqueducts, sewers, pipes, fire hose, hydraulic giants, power mains, nozzles, reducers, etc., with extensive tables and data of cost of pipes and trenching and pipe line construction. By Marvin E. Sullivan, B. Ph., LL. B., Hydraulic Engineer. 301 pp., $3 in cloth, $4 in leather, pocket edition. Mining Reporter Press, Denver, Col.

The comprehensive sub-title of Mr. Sullivan's book shows the field which it is intended to cover, and an examination of the book shows that it is a valuable book for practical use in design and construction. It is hardly proper to call the book a new hydraulics, for the only new contribution to the basis of the subject is Mr. Sullivan's proposed new formula for the flow of water in pipes and channels, hardly sufficient to warrant the claim of a new science of hydraulics.

The principles upon which the formula is based are best stated in a "Correction of Text" on page 237, in which there is a material change in the position of the author. He declares that the effective value of a constant head or slope varies with some function of the hydraulic mean radius (the square root of the cube), and that the coefficient of discharge does not vary with head, slope, velocity or hydraulic mean radius but only with roughness of the wet perimeter.

The experiments selected to test the formula show excellent agreement. Many results of former experimentation are rejected on account of lack of sufficient data and consequent lack of confidence in the exact meaning of the data. Mr. Sullivan is equally indefinite in his statement of many of the data of his experiments, and for his own reasons the results of his experiments should be received with great caution. There are several statements as unsupported as the following from page 140: "From the results of many experiments with very small nozzles and large nozzles of cast iron from 8 to 12 feet in length, the writer has discovered that the friction in a nozzle or convergent pipe is nine times as great as in a pipe of uniform diameter, which uniform diameter equals the mean diameter of convergent pipe, both being of the same material and same length, and discharging equal quantities of water in equal times." The exact value of the factor may be 9, but detail of the experiments would put some confidence into the reader that Mr. Sullivan has drawn the right conclusion from the study of them. This is true even of the small number of experiments upon which the new formula is based.

The numerous repetitions, corrections of statement and of argument and infelicities of arrangement are doubtless due to lack of practice in expression, and the form of the book, type used, and errors in characters in formula, show lack of familiarity of the printer with this class of work. Mr. Sullivan is more consistent in spelling "guage" than in following his courses of reasoning.

Most of this criticism is upon the word "new" in the title. Aside from this, the book has a large number of valuable and convenient formulae and tables of use to every hydraulic engineer, and is a notably valuable contribution to the literature of hydraulics.

The Little Engineer: a Pocket Book of Instant Answers. By Joseph B. Rider. 528 pages. $3. Published by the author, South Norwalk, Conn.

We have for examination a few advance pages from this book which indicate its character and the place it is intended to fill. It is a collection of short cuts to answers to questions and many of the answers themselves in the various branches of mechanical and civil engineering connected with the design and operation of water works and sewerage systems, pavements, and the materials used in them. A few of the features of the book may be mentioned here, and a more complete review of it will be given later.

One set of valuable tables gives the flow in water pipes computed by Greene's formula, which the author has verified by a number of observations and computations of the results of observation by others. There is a table for each size of pipe from 4 inches to 48 inches, two pages for each size, giving for velocities from 0.1 to 15 feet per second, the grade required to produce the velocity in feet per 100 feet, per mile, and length for one foot difference in head; the pressure lost in pounds per square inch per 1,000 feet and per mile; and the discharge in cubic feet per second in U. S. gallons per minute and per hour, in

millions per day, and in miners' inches under 4-inch head; also the cost of materials and labor for laying. Weights of pipe and of special castings are given in detail; also thickness of standpipe plates and bottoms.

There are many tables required in steam engineering—pressure, temperature, boiler feed water, size of chimneys, properties of steam, heat units required for various purposes, etc., etc. Dams and walls receive much consideration.

Sewerage occupies considerable space. Mr. Rider's tables, published in 1890, are reproduced, giving velocity and discharge for each size of vitrified sewer pipe from 6 to 36 inches, and the fall necessary to produce the velocity given, in length per foot of fall and in feet fall per hundred feet from 0.05 to 6 feet per 100. Cost of laying pipe is given in detail. Sewage disposal receives its share of attention. Mr. Rider is more definite and comprehensive in his statements of the results possible from contact beds than his contemporary engineers. It may be that our future experience will fully justify him. At any rate his table and conclusions will serve as a general statement of what may be expected under the best conditions.

"The Relation of the Subsiding Basin to Water Purification and Information Relating to Water Clarification" is the title of a paper by Wynkoop Kiersted, M. Am. Soc. C. E., Kansas City, Mo., describing some plants of this nature which he has constructed and the results of their operation.

The Osborn Engineering company, Osborn building, Cleveland, O., publishes a blank form for contract and full specifications for highway bridge superstructures to meet the demand for such a form. It is well arranged and indexed so that all the requirements made are easily found and is abreast of the latest and best practice.

The new reservoir of the water works of Trenton, N. J., is described in a handsome illustrated pamphlet by Charles A. Hague, M. Am. Soc. C. E., the designing and constructing engineer.

Municipal Reports.

Annual Reports of City Engineer, Superintendent of Parks and Health Officer of Mankato, Minn. J. R. Thompson, City Engineer; Geo. E. Blake, Supt. of Parks; Dr. J. S. Holbrook, Health Officer.

Some mention of this report was given in our June number. The city engineer's report gives a full statement of the sewer system so far as constructed, the length and size of each line, number and kind of appurtenances and total cost. A notable feature of the system is the amount of cement pipe. About 40 per cent. of the sewer system was constructed before 1891, and of this amount all but 870 feet was pipe sewer. Pipes of more than 12 inches in diameter are vitrified clay; those of 12 inches or under were made of Mankato cement. The same rule was adhered to until 1894 with an occasional 15-inch oval sewer of cement. In that year some vitrified clay sewers of the smaller sizes were laid. Since 1897 all sewers seem to be laid with vitrified clay.

The water works system has 942 water takers, received $12,498 in the year and expended $11,254, including $4,005 interest and $1,689 repairs and maintenance.

The population is 10,600, of which 6,600 use the city water. The average daily use for the 6,600 users, after deducting 30,000,000 gallons free water per year, is 136 gallons. The average pumpage per day is slightly less than 1,000,000 gallons. The cost of pumping 1,000,000 gallons against the 223 feet head at the works was $15.25, based on running expenses of pumping station ($5,495), $13.75 with maintenances charges added, ($1,689) and $45.37 with interest on cost of plant, and depreciation added. (Total cost $16,241.) We are indebted to City Engineer Thompson for the illustrations of Sibley park appearing on our pages. They indicate the natural beauties of the park location and the skill of the park commissioners and superintendent in taking advantage of them. The commissioner's report shows that the work is done at very slight expense in comparison with the results attained.

Report on Increasing the Water Supply of the City of Norwich, Conn., by Hill, Quick and Allen, Consulting Engineers. Adopted by Water Commissioners and Council May 3 and 6, 1901.

This report is an excellent example of thorough methods of investigation of an engineering question. The present system is described; careful estimates are made of the future population and consumption, a diagram showing to the eye the results of the consideration of the question; plans for supplying the deficiency in the supply are then considered, including the restriction of consumption by meters, additional storage and development of new supplies. From the conditions in Norwich the judgment is formed that the present average consumption of ninety gallons per capita could be reduced scarcely more than five gallons by the use of meters, the installation of which would cost $70,000. Other methods of determining and preventing waste are not discussed in the report. The project for additional storage is discussed with an estimate showing its great cost for the increase possible. Four new sources are discussed in detail, and a choice between a supply by pumping and a gravity supply at greater first cost is offered, the latter having a decided preference. Interesting features of the report are the tables and diagram show-

ing the yield of the various watersheds for a number of years, the available draft under various conditions of storage, and surplus available for mill purposes.

Report of the Department of Fire Service of the City of Cleveland, O., for the Year Ending Dec. 31, 1900. H. H. Hyman, Director of Fire Service.

The cost of the Cleveland fire department for 1900 was $524,725.26. There were 418 names on the pay-roll, 154 horses, 124 pieces of apparatus and 44,050 feet of hose. There were 1,492 alarms, 52 false. The losses by fire during the year were $944,752.58. The value of the work of the department may be judged to some extent by the statements that the insurance paid was $821,658.43 and the insurance on the property endangered was $4,662,241. The actual value of the property endangered is much larger than the insurance carried, but there are no figures to show what it actually is. The various engines ran 9,118 miles to fires, used 431,850 feet of hose and the companies, counting each company as a unit, worked 2,542 hours. The boiler inspector, building inspector and electrician are under this department. The amount of subway built was 108,816 feet, containing 615,329 feet of ducts and 159,127,621 feet of wire. The total amount of wire now underground in the city is 63,026 miles.

Sixth Annual Report of the Municipal Commission of Herkimer, N. Y., Henry Churchill Pres. E. W. Sluyter, Clerk and Supt.

The city of Herkimer owns an arc street lighting system, an incandescent or commercial lighting system, a water supply nd has a sewer system on the separate plan all in charge of the municipal commission. The report is well itemized to show the cost of constructing and maintaining each system and approaches very closely to the model report of a summary of operations to show their net results. An argument for municipal ownership is presented which is well based. There is sufficient detail of distribution of superintendence, labor and material accounts to show the correctness of the method used, and depreciation of plant is allowed for at 2 per cent. of the cost for the water system and at 5 per cent for the other revenue producers. Balance sheet and treasurer's statement give the totals of assets and liabilities, receipts and expenditures, and maintenance accounts for arc and incandescent lights, water, sewers, police and fire departments give the details. From these accounts the cost of street lights for actual expense of running 3,344 hours, 75 lamps, is $55.71 per lamp, adding interest on bonds outstanding the cost is $63.18, adding depreciation, it is $76.22 and adding taxes it is $77.72.

Incandescent lights, including interest and depreciation, but not taxes, show a profit of $2,332.24, on receipts of $6,513.72, plant costing $21,274.42. Water shows a profit of $2,753.19 on receipts of $10,734.09 ($10,119.91 cash and balance charged to various village funds), plant costing $76,171.83.

This report shows one of the advantages of having all the industrial activity of the village departments under one management, thus unifying the work, saving duplication of expense and permitting the employment of a more competent supervisor.

Personal Notes.

W. A. Booker has resigned as city engineer of Rawlins, Wyo.

Hon. Thomas T. Huey has been re-elected mayor at Bessemer, Ala.

W. H. Clark has been elected president of the council at Ottawa, Kas.

Morrell Vrooman of Ft. Plain, N. Y., has been appointed city engineer at Gloversville, N. Y.

Perry Okey has been appointed superintendent of the municipal light plant at Columbus, O.

Cornelius P. Nolan has been appointed assistant water superintendent of South Orange, N. J.

F. D. Culver has been appointed city clerk to succeed Christ. Weisgerber, resigned, at Lewiston, Idaho.

The Hon. James L. Compton, mayor of Perth Amboy, N. J., has resigned on account of ill health.

G. H. Peck has resigned as superintendent of water works at Lestershire, N. Y., to accept a position at Endicott, N. Y.

C. S. Currier has resigned as city engineer of Barre, Vt., which position he has held since the incorporation of that city.

E. R. Head has been elected president of the newly organized board of water commissioners at Kenosha, Wis.

Frank L. Clifford, engineer of the electric light plant and superintendent of the water plant at North Vernon, Ind., has resigned.

E. M. Scofield, Assoc. M. Am. Soc. C. E., has resigned as manager of the Youngstown plant of the American Bridge Company.

Prof. E. Haviland, Jr., has been appointed to the chair of civil engineering at the Clarkson School of Technology, Potsdam, N. Y.

Prof. Louis Ash has resigned the chair of mathematics at Coe college, Ia., to accept a position as civil engineer in Kansas City, Mo.

George W. Carpenter, for thirty-six years superintendent of the water works at Albany, N. Y., died last week in that city, aged ninety years.

W. A. Foster of San Pedro has been appointed city engineer at Long Beach, Cal.

Allen F. Gill has been appointed city engineer at Spokane, Wash.

Crawford Lindesay, assistant engineer to the Durban town council, Natal, has been appointed engineer of the borough of Salisbury, Rhodesia, South Africa.

Jack Hinkle has been appointed deputy director of public improvements and secretary of the water works department at Columbus, O., to succeed J. B. Miles, resigned.

W. S. Barstow, M. Am. Inst. C. E., who has been connected for twelve years with the Edison Illuminating Company of Brook-

lyn, and its successor, the Kings County Gas, Electric Light and Power Company, has established an office as consulting engineer at 11 Broadway, New York City.

George W. Scott, consulting engineer, has established offices at 616 Rookery Bldg., Chicago, Ill., where he will make a specialty of shops, power plants and industrial works.

Winter L. Wilson, for several years an instructor in civil engineering at Lehigh university, has been elected professor of civil engineering at the Tulane university of Louisiana, in New Orleans.

Frank J. Llewellyn has been appointed manager of the contracting department of the American Bridge Company and will have charge of the entire western division, with headquarters at Chicago.

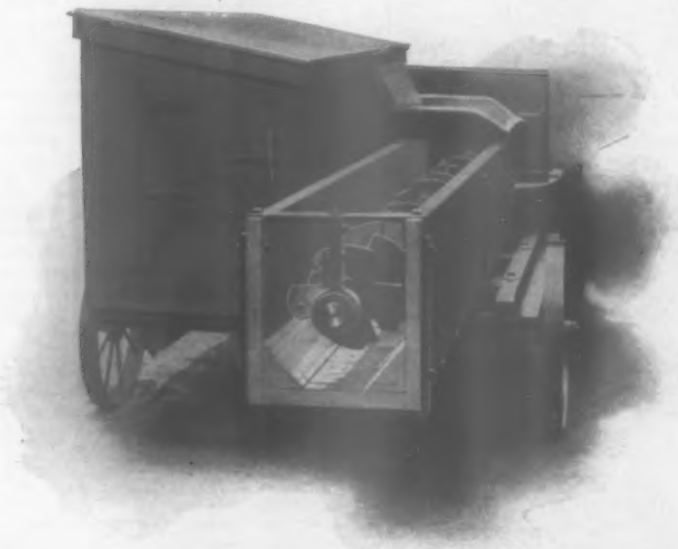
Yeyi Nakajima, chief engineer of Tokio, Japan, is visiting America for the purpose of studying sewerage systems. He is accompanied by R. Naoki, an engineer of Tokio, and I. Omita and H. Mayesawa, who are students in the Imperial university. They will return to Japan by way of Europe in October.

Elmer G. Manahan, who has been connected with the Metropolitan Water Works, Boston, for six years, has resigned to accept a position with the bureau of water filtration, Pittsburg. Harold K. Barrows also has resigned from the service of the Metropolitan Water Works, to become assistant professor of hydraulics at the University of Vermont.

MACHINERY AND TRADE.

Mortar and Concrete Mixer.

The accompanying illustration represents a mortar and concrete mixer made by the Jeffrey Manufacturing Company of Columbus. As will be seen the mixing trough, which is substantially built of wood and iron, is supplied with a special spiral conveyor made so as to cut, turn over and thoroughly mix the material, at the same time carrying it to the end of the box. This machine has been built for mixing mortar, sand, concrete, cement and similar material. The power is furnished by gas or gasoline engine, the mixer and driving connections are mounted on a platform provided with wheels and axles. The platform has a hinged leg at one end and a tongue at the other. The leg serves as a support, while the mixer is in use, the tongue for moving it from place to place by attaching it to the rear end of a wagon. The mixer is also sold without the platform and arranged to be driven by horse power when desired. The machine mixes the mortar thoroughly in a uniform manner, producing, it is claimed, a product far superior to hand mixing, enabling the masons to accomplish more work than where hand-mixed mortar is used. It can be readily moved from place to place, discharging the material directly where it is to be used.



JEFFREY MORTAR AND CONCRETE MIXER.

Vapor Lights For Cities.

The modern lamp burning gasoline produces a brilliant light at very low cost and with little attention. The Cleveland or Columbia lights of the Cleveland Vapor Light Company, Cleveland, O., are among the most satisfactory designs in appearance, in durability and in ease of operation. The ordinary street lamp requiring daily filling is durable and very economical. The cost of operation, in comparison with gas or electric light of equal illuminating power, is very low. Their modern park design is one of the handsomest lamps of any sort in use. It harmonizes well with its surroundings, is the cheapest to install, requiring nothing but the posts and lamps, the fuel and labor required are a minimum, and the light gives eminent satisfaction. One of the designs is so constructed that by turning an indicator to the proper figure the amount of gasoline necessary to burn the given number of hours is let into the service reservoir, and when this amount is consumed the light goes out, thus saving the labor of extinguishing and the extra gasoline required. One of these lamps may burn the required number of hours each night with filling but once a week. Five thousand of the park design have been purchased recently by the city of Cleveland.

Trade Publications.

The Contractors' Tool company, 118 S. Sixth-st., Philadelphia, Pa., issues a circular and price list of Allen's Water-Level Indicator Gauge Glasses.

The Niagara Falls Power company, Niagara Falls, N. Y., sends a handsomely illustrated pamphlet giving descriptions of their power plant and distributing system and of the various manufacturing industries now taking hydraulic or electric power from the company; also the power used in electric lighting and street and interurban railway lines. No better statement of the many uses to be made of electric power can be found than in this booklet. The story of the development of this company and of the industries served by it is that of the development of the application of electricity to practical uses.

A circular gives the "Reasons why the Berger instruments are acknowledged the standard of excellence" and refers to their larger catalogue for details. C. L. Berger & Sons, Boston, Mass., are the manufacturers.

The general specifications for steel highway bridges, prepared for the use of the engineering and operating departments of the American Bridge company, C. C. Schneider, Vice-President in charge, have been printed for distribution as a full statement of the manner in which bridges will be built by this company unless other specifications are required by the purchaser. They are certainly sufficient to secure a first-class bridge if strictly followed.

Electric locomotives of the many styles manufactured by the Jeffrey Manufacturing company of Columbus, O., are described and photographed in a handsome booklet. The tables of dimensions, capacities of drawbar pull on various grades, gross train loads that can be hauled will be found very convenient. Some special apparatus and fittings are also shown in the catalogue.

Baker & Co., platinum refiners, Newark, N. J., present a booklet entitled "The Alchemistic Symbols: A Brief Account of Their Origin and Meaning," by James Lewis Howe of Washington and Lee university which gives some curious information on the subject and serves to carry the name of the publisher to the eye of the reader.

J. G. Timolat, 464 West Broadway, New York, publishes a recent decision of the United States circuit court, sustaining the patent for the improved Moffet portable drill.

Trade Notes.

ASPHALT.

The mill of the Art Portland Cement Company, Sandusky, O., is no longer in operation.

Asphalt has been found at Sulphur Mountain, near the line of Boone and Newton counties, Arkansas.

A bed of asphalt has been discovered near Hartsells, Ala., by Capt. A. F. Lucas, which he will put on the market this fall.

The Indiana Oil and Asphalt Company was incorporated at Indianapolis, Ind., recently, by Mortimer Levering, Fred M. Murdock, W. F. Murdock, H. W. Marshall, North Parke; George J. Eacock and Daniel E. Storms of Lafayette, Ind. The company will have a branch office at Lafayette.

J. J. Chapman of Ravia, Ind. T., has organized a syndicate in St. Louis, Mo., to open the asphalt beds on Mill Creek, 3 miles east of Ravia. The asphalt is said to be of the finest quality and a vein 5 to 6 feet wide has been traced on the surface for 8 miles.

A company boring for oil 6 miles north of Palopinto, Tex., found asphalt in large quantities at depth of about 600 feet.

The Federal Asphalt Company has been organized with a capital stock of $5,000,000. The officers are: President, M. D. Coffeen; vice-president, Joseph Huffaker; treasurer, A. H. Loeb; secretary, F. L. Warner; general counsel, Azel F. Hatch. The company owns 23,000 acres of asphalt lands in Hardin, Grayson, Edmondson, Hart and Warren

counties in Kentucky. It will be incorporated under the West Virginia laws.

BRICK.

The Poston Paving Brick Company, Crawfordsville, Ind., will increase the capacity of its plant.

The Purington Paving Brick Company, Galesburg, Ill., contemplates improving and increasing its plant. Plans have been made for the erection of seven or eight new kilns. The improvements will cost about $50,000.

A new paving brick plant is being built at Utica, Mo., by Seiser & Purdum.

A new company has been organized at Pueblo, Col., to manufacture building, paving and fire brick. J. K. Dempsey is manager.

CEMENT.

The Portland Cement Company of Portland, Col., has been incorporated by C. Leonard, Aman Moore, Jas. A. McCandless and Lyman Robinson. The company has 800 acres of cement land in Fremont county, which is pronounced by experts to be the finest deposit in the world. The company will build a plant immediately. The main building will be 100x500 feet and will be of structural iron with cement concrete walls, roof, floors, foundations for machinery, water tanks and smoke stack. The plant will be in operation by March, 1902. The company will manufacture the "Ideal" brand of Portland cement. The officers of the company are: President, John A. Thatcher; vice-president, S. Leonhardt; secretary and treasurer, M. B. Toy; general manager, Aman Moore.

The Colorado Fuel and Iron Company contemplates building a plant for manufacturing Portland cement. The company has purchased 300 acres of ground six miles east of Florence, which has a heavy deposit of lime shale containing the right proportion of silica to make a first-class grade of Portland cement.

The Iola Portland Cement Company of Iola, Kan., has been awarded the contract by the Davenport Water Company of Davenport, Ia., for 6,500 barrels of cement, to be used in the construction of the new sedimentation basin.

The Lehigh Portland Cement Company of Allentown, Pa., will erect a large cement plant of 2,200 barrels capacity daily, within the corporate limits of Mitchell, Ind., at a cost of $40,000. The plant will have its own electric lighting system.

The Vulcanite Portland Cement Company, Philadelphia, Pa., is now erecting on their property at Vulcanite, Warren county, New Jersey, an aditional mill of 2,000 barrels capacity a day. The mill will be in operation January, 1902, after which date the company will be prepared to supply 4,000 barrels daily.

The Chickamauga Cement Company, Rossville, Ga., contemplates building an addition to its plant.

Plans for a plant 50x200 feet are being made for the Newaygo Cement Company, Newaygo, Mich.

The Union Cement and Lime Company, Louisville, Ky., has been incorporated.

The Commercial Club of Chickasha, I. T., is considering a proposition for a cement plant.

New machinery will be installed in the Union City cement plant at Tegonsha, Mich.

The Helderberg Cement Company, Albany, N. Y., recently organized, has elected directors as follows: T. Henry Dumary, John W. McNamara, William McEwan, Anthony N. Brady, Robert C. Pruyn, John G. Meyers, F. W. Kelley, James C. Farrelt, Thomas E. Murray, E. L. Pruyn, C. H. Ramsey and James B. McEwan.

The International Cement Company has secured a site at Aliquippa, on the Ohio river, according to press reports and a plant will be erected at once.

The Illinois Steel Company will erect a cement storage elevator at its works in South Chicago.

A cement testing plant is being established at St. Andrew's Rapids by the Dominion public works department of Winnipeg, Man.

A company has been formed of local and eastern capitalists to erect a plant and purchase equipment for manufacturing cement at Corona, Cal.

Capitalists are talking of establishing a cement plant near Annville, Pa., according to press reports.

A. C. McComb has secured an option on a rich bed of marl three miles from Amherst, Wis., and contemplates the establishment of a Portland cement plant.

Judge Rogers of the federal court, Ft. Smith, Ark., filed an opinion Aug. 20, approving the recent sale of the property of the White Cliffs Cement Company, by which the Dutch owners of the second mortgage secured possession of the property for $100,000. Their representative paid in $130,000, which was sufficient to take up the first mortgage bonds, which were canceled when $30,000 more to cover costs, attorneys' fees, etc., was paid over.

SEWER PIPE.

A sewer pipe plant and tile mill will be opened at Bethlehem, Pa., by E. L. Thomas.

A petition in bankruptcy was filed recently by the Red Wing Sewer Pipe Company, Red Wing, Minn. The liabilities are reported at $45,290.60, and the assets at $800, of which latter $250 is exempt.

The Standish Sewer Pipe Works, New Cumberland, W. Va., which were recently acquired by the American Sewer Pipe Company, will probably not be placed in operation until next season.

The establishment of extensive sewer pipe works at Port Homer is contemplated by capitalists of Toronto, O., according to press reports.

LIGHT, HEAT AND POWER.

A plant for the manufacture of gas and gasoline engines and naphtha launches is proposed at Port Huron, Mich. J. C. Mackay of Pontiac is interested.

The Dirigo Gas, Light and Heating Company, Portland, Me., has been organized to manufacture acetylene gas generators. The officers are: President, E. H. Gerrish, Portland; treasurer, F. N. Mayberry, Portland.

The Saline Acetylene Gas Company, Detroit, Mich., has been incorporated with the following officers: President, Charles Burk-

hart; clerk, Andrew J. Warren; treasurer, Charles F. Unterkircher.

The Ideal Light Company, Canton, O., which was recently incorporated to manufacture incandescent lights, is establishing a factory. Officers have been elected as follows: President, Elmer G. Myers; vice-president, John P. Schilling; secretary, Charles Schilling; treasurer, Carl Holfrath; general manager, George C. Dunlap.

The American Light and Traction Company has absorbed the Binghamton Gas Company of Binghamton, N. Y.

Newly incorporated light companies: Hennessey Electric Light and Power Company, Hennessey, Ok. T., Lawton, Ok. T.; Tunica Electric Light and Power Company, Tunica, Miss.; Georgetown Water, Light and Power Company, Georgetown, Ky.

MISCELLANEOUS.

The Joliet Quarries Company has been incorporated to do stone quarrying and mining by Charles B. Gurnsey, August F. Knox and John B. Ramsey.

The Joliet Artificial Stone Company, Joliet, Ill., has been organized to convert the spoils bank into crushed stone to be used for concrete and ballast. The officers are: President, Werden Buck; vice-president, D. D. Monahan; secretary and treasurer, John B. Mount.

A creosoting plant will be erected at Terre Haute, Ind., by Erler & Peters to be known as the Terre Haute Creosoting Company.

The Shawnee Sewerage and Drainage Company, Shawnee, Ok. T., has been incorporated by C. R. DeBruler, Walter Newman and F. M. Richards.

The Mohawk Construction Company, Amsterdam, N. Y., has been incorporated to construct buildings, highways, bridges, railways and other private and public structures and utilities.

The Anderson Water Meter Company, New York City, filed articles of incorporation at Dover, Del., Sept. 11, to manufacture and sell water meters of all kinds. The incorporators are: Woodville Flemming and John W. Reardon, New York City; Abner P. Pitner, Riverside, Pa.

The Vacuum Pulley Covering Company, Brooklyn, N. Y., has been incorporated to manufacture and sell cement for covering pulleys. The directors are: Thos. W. Bollars, Jr., of Glen Cove; Adam Kessel, Jr., 45 Deverse-st., Brooklyn; Chas. D. Sternfels, of Manhattan.

City Engineer Gregg and Geo. Wright of Kankakee, Ill., have secured an option on forty-six acres of land near that city, which they believe is well suited to concrete purposes and cement work, as well as building material. A stock company will probably be organized to open the quarry and place the product on the market.

Recent Inventions.

673,176. April 30, 1901. Clamp for Trolley Wires. James W. Perry, Philadelphia, Pa., assignor to H. W. Johns Manufacturing company of New Jersey. A crossing or switch with rigid clamping arm and grooved jaw, receiving wire and moving laterally to clamp it.

673,186. April 30, 1901. Means for Retracting Trolleys. Thomas J. White, St. Louis, Mo. A drum actuated by spring and a trigger to set spring in action to retract trolley.

673,196. April 30, 1901. Mixing Apparatus. John B. Cline, Jefferson, Ia., assignor of one-half to D. L. Haword, same place. Two truncated pyramids set bases together and revolving on their common horizontal axis.

673,275. April 30, 1901. Composition of Matter for Street Paving or Other Purposes. Charles R. Long, John S. Miller and William F. Ingram, Louisville, Ky. A compound of natural sandstone rock asphalt, with magnesian minerals and cementing material, such as steatite, talc, terra alba, serpentine, ozocerite and lake pitch or Trinidad asphalt.

673,310. April 30, 1901. Construction of Ceilings, Floors, etc., of Iron and Concrete. Gustav A. Wayss, Charlottenburg, Germany. Provided with embedded bundles, consisting of a member in the lower part of the construction and links leading to the upper part, and having hook-shaped ends united to the member by bolts.

673,398. May 7, 1901. Filter or Strainer for Well Tubes. Anthony Keller and Michael Jeffers, Plymouth, Ind. A perforated tube section wound with round wire, having indentations on both sides, one coil registering with another to form meshes for passage of water.

673,577. May 7, 1901. Means for Cleaning Settling Basins. Ira H. Jewell, Chicago, Ill. A pump traveling over a continuously acting settling basin with a suction pipe, for lifting sediment from the bottom of the basin without interrupting its usual operation.

673,734. May 7, 1901. Street Sweeper. Giovanni B. Siccardi, Washington, D. C. A hand sweeping machine with scraper revolving brush, sprinkler and elevator.

673,780. May 7, 1901. Concrete Pile. Gustave L. Mouchel, London, Eng. Pile body molded in lengths, cavities in ends surrounded by binding rods molded in the concrete, core piece, fitting in cavities, metal collar clamped around abutting ends, cement filling for joint.

673,852. May 7, 1901. Tubbing for Tunneling Devices. Wm. S. MacHarg, Chicago, Ill. A series of annular sections joined together end to end and comprising each a series of short blocks tongued and grooved at their meeting edges, and wedge blocks adapted to tighten the short blocks in the annular section of tubbing, one of the blocks being in short sections.

673,856. May 7, 1901. Pulverizing Mill. Horace L. Kent, Brooklyn, N. Y. A laterally-yielding revolving ring, crushing rolls within and supporting it, casing, rings in casing to keep uncrushed material in, springs for cushioning the rolls, and outlets for crushed materials.

673,920. May 14, 1901. Excavating Machine. James H. McKee, Chicago, Ill., assignor to Frederick C. Austin, same place. A swinging frame carrying chain of excavating buckets, an extended guard to keep dirt in until conveyor is reached, means for cleaning diggers, for raising and lowering frame and operating drum.

674,287. May 14, 1901. Frame for Pavements. Geo. K. Tinker, New York, N. Y. A frame for pavements consisting of a blank of expanded metal corrugated trans-

versely to the longitudinal axis of its meshes, the connecting portions being at different hights in successive corrugations.

674,296. May 14, 1901. Method of and Apparatus for the Manufacture of Cement Pipes. Carl J. Kielberg, Hillerod, Denmark. Inner and outer molding cases, the latter allowing for bell, base, rotating cylindrical compressor, with spiral lip, and driving shaft.

674,319. May 14, 1901. Refuse Crematory. Ward Risley, Jacksboro, Tex. A roasting chamber, with garbage grate, fire grates below, some gases passing under and some both over and under garbage grate, an evaporating pan below, charging doors and tubes, part arranged for automatic flushing, and means of carrying off gases.

674,703. May 21, 1901. Road Scraper. Edward P. Lynch, Salt Lake City, Utah, assignor to the Aultman company, Canton, O. A scraper, on a well-supported frame with adjuster, lock and method of operating same.

674,672. May 21, 1901. Paving Block. Reuben D. Culver, Veedersburg, Ind. Special forms of horizontal and vertical grooves on vertical faces of blocks.

676,432. June 18, 1901. Scraper. Thos. J. Henry, Arion, Ia. A scraper with a V-shaped drawbar and projections for supporting scraper when tilted.

676,569. June 18, 1901. Wall, Partition, Slab, Block, etc. Gustav L. Mouchel, London, Eng. A wall body of concrete and embedded in it straight stiffening metal bars and curved rigid bars at right angles.

676,638. June 18, 1901. Drying Device for Cement Kilns. Harry Stehmann, Hoboken, N. J. Apparatus for diverting heated gases from cement kiln top through an adjacent drying drum.

IMPROVEMENT AND CONTRACTING NEWS.

PAVING.

Chicago, Ill.—Mayor Harrison has issued orders forbidding steam boilers under sidewalks.

Milwaukee, Wis.—The judiciary committee of the council is considering the question of admitting land asphalt to competition.

Nashville, Tenn.—The construction of a stretch of model road in this city for the good roads convention to be held here in October has been placed in charge of Robert T. Creighton.

CONTEMPLATED WORK.

Farmington, Conn.—Main-st. will be macadamized.

Helena, Mont.—Paving is contemplated for E. Park-st.

West Superior, Wis.—The citizens on Tower-st. favor brick paving.

Grinnell, Ia.—A stone walk will be built in front of the Stewart library.

Sharpsburg, Pa.—Paving is contemplated for Davidson-st. and Linden-ave.

Spencer, Ind.—The construction of paving brick crossings is contemplated.

Saginaw, Mich.—Baum-st., between Tuscola and Johnson, will be paved with brick.

Albany, N. Y.—The extension of Manning boulevard is proposed at a cost of $40,000.

Newburgh, N. Y.—The estimated cost of paving Broadway with granite blocks is $47,000.

West Hoboken, N. J.—The estimated cost of asphalt paving on Palisade-ave. is $36,382.

Liberty, Ind.—An ordinance has been passed requiring cement walks on Vine-st.

Lafayette, Ind.—Quincy-st., between Ellsworth and Littleton-sts., will be improved.

St. John, N. B.—Bids for about 12,000 sq. yds. of asphalt paving will be asked for.

Albany, N. Y.—Rolin-st., from West to Sherman, will be paved with brick. Mayor Blessing.

Irwin, Pa.—The remainder of Main-st. and Pennslyvania-ave. will be paved this fall.

Leavenworth, Kas.—Walnut-st., from Third to Fifth, will be paved. Mayor Ryan.

Butte, Mont.—Petitions are being circulated for paving E. Park-st., east from Arizona.

Birmingham, Ala.—Action on the ordinance for paving Fifth-st. was deferred until Oct 16.

Sumter, S. C.—The city council is considering a proposition to lay artificial stone pavements.

Traverse City, Mich.—Peninsular township has voted to issue $20,000 highway improvement bonds.

Big Rapids, Mich.—Street Commissioner Brower has been authorized to build cement cross walks.

Sedalia, Mo.—Resolutions have been passed for paving Third-st. with vitrified brick.

Geneva, N. Y.—The question of sidewalk construction in Pulteney-st. is being discussed.

Tampa, Fla.—The question of issuing $400,000 county road bonds will be voted on Oct. 8.

Walla Walla, Wash.—The proposed route to the penitentiary, about eleven blocks, will be macadamized.

Alton, Ill.—Ordinances have been adopted for building brick walks on Sixth and Tenth-sts.

Rockford, Ill.—Petitions have been circulated for macadamizing N. Horsman-st. and Rockton-ave.

Woonsocket, R. I.—Bids for macadamizing four streets will be asked for by City Engineer Mills.

Braddock, Pa.—The question of issuing $100,000 street improvement bonds will be voted on in November.

Beaumont, Tex.—Bids will be asked soon for about 35,000 sq. yds. of brick paving. F. C. King, cy. clk.

New Brighton, Pa.—The question of issuing bonds for constructing 22 mls. of streets will be voted on.

Mattoon, Ill.—Ordinances have been passed providing for concrete walks on certain streets. Mayor Fry.

Joliet, Ill.—The residents on Julius-st. are agitating the question of macadamizing that street.

Newark, N. J.—The question of paving Avon-ave. with granite block on sand foundation is being agitated.

Muskegon, Mich.—Brick paving is contemplated for Houston-ave., from Peck to Ninth-st. Mayor Moore,

Luverne, Minn.—Cement walks will be constructed on Cedar, Lincoln, Spring, Maple, Main and Freeman-sts.

Lee, Mass.—The sum of $5,500 has been appropriated for constructing walks and curbing in Laurel-st.

Rochester, N. Y.—The construction of cement walks in six streets is contemplated. F. S. Pulver, cy. clk.

Mishawaka, Ind.—The question of paving Second-st. with asphalt, brick or macadam is being considered.

Peotone, Ill.—The board of trustees has ordered the construction of a concrete walk adjoining certain lots.

Winnipeg, Man.—Balmoral-st., from Portage-ave, to Broadway, will be macadamized C. J. Brown, cy. clk.

Rensselaer, Ind.—Sidewalks in a number of streets have been considered and ordered rebuilt with cement.

Vancouver, B. C.—The construction of sidewalks on Columbia-ave., Eighth-ave. and other streets is contemplated.

Murphysboro, Ill.—The need and cost of paving the streets of this city is being considered by the citizens.

South Norwalk, Conn.—The citizens have decided in favor of repaving E. Washington-st. with vitrified brick.

Sydney, N. S,—The town council has voted to issue $25,000 bonds for street improvements, sewerage and water.

Los Angeles, Cal.—Asphalt paving, to replace the present brick paving on Orange and State-sts. is proposed.

Traverse City, Mich.—Cement walks in front of certain properties have been recommended. Chas. M. Beers, cy. clk.

Fairmount, W. Va.—The city engineer has been directed to make an estimate of the cost of improving Monroe-st.

Rome, N. Y.—City Engineer Capron has been directed to advertise for bids for paving E. Liberty-st. with asphalt.

Cohoes, N. Y.—The board of public works decided Sept. 23 to proceed with the repairs to the Railroad-st. pavement.

Troy, N. Y.—Specifications have been prepared for paving Second-ave., North End, from First-st. to Waterford bridge.

Monmouth, Ill.—Ordinances have been passed providing for the paving of N. First-st. from Broadway to Euclid-ave.

Ypsilanti, Mich.—Resolutions have been passed for constructing cement walks on a number of streets. W. E. McLeod, cy. clk.

Pittston, Pa.—This town is undecided whether to use macadam or brick for the proposed paving. W. C. Sutherland, chmn. st. com.

Iowa City, Ia.—The property-owners on Bloomington-st., between Clinton and Duluque-sts., have petitioned for asphalt paving.

Meadville, Pa.—A resolution has been passed to extend the cement sidewalk on River-st. to Chestnut-st. Cy. Engr. Doane.

Newark, N. J.—Granite block paving on sand foundation is contemplated for Avon-ave. between Belmont-ave. and Bergen-st.

Pekin, Ill.—An ordinance has been passed for paving Fourth, Elizabeth and Capitol-sts. with brick. Charles J. Skaggs, cy. clk.

Norfolk, Va.—A resolution has been passed for paving with Belgian block or asphalt, with curbing, a portion of Washington-st.

Chelsea, Mass.—The construction of 3-5-mi. of state highway through this town has been authorized. A. L. Maggie, cy. engr.

Sioux Falls, S. D.—A resolution has been passed for a cement walk on Main-ave, between Second and Third-sts. Mayor Burnside.

Marshall, Mo.—A resolution has been passed for macadamizing, curbing and guttering Salt Pond-ave. from North to Washington.

Crawfordsville, Ind.—A resolution has been adopted for constructing a cement walk on the west side of Main-st. Cy. Engr. Simpson.

Battlecreek, Mich.—Estimates will be made for building cement walks on High and Manchester-sts. and Hamblin-ave. Mayor Gillette.

Baker City, Or.—An ordinance was passed recently providing that all wooden walks along Front-st. be replaced with cement walks.

Pentwater, Mich.—Ordinances have been passed for constructing cement walks in certain streets. Prest. Alton of common council.

Zionsville, Ind.—The property-owners on Third-st., from Main to Lebanon, have petitioned for cement walks. Bert A. Mills, town clerk.

Marseilles, Ill.—Ordinances have been passed for constructing a cement walk on Bluff-st. G. C. Stebbins, mayor; George Nelson, cy. clk.

Springfield, O.—Cement walks will be built on S. Limestone-st., from the Big Four tracks to Clifton-st. W. H. Sieverling, cy. engr.

Woburn, Mass.—Appropriations have been made for the following: Macadam streets, $27,000; new edgestone and concrete walks, $3,000.

Marion, Ia.—A resolution has been passed to pave Twelfth and Thirteenth-sts., between Seventh and Eighth-ave., with asphalt. P. M. Plumb, mayor.

Peoria, Ill.—Ordinances were adopted Sept. 17, providing for brick paving on Glen Oak-ave. and cement sidewalks on a number of streets.

Washington, Pa.—The council of West Washington has decided to pave Chestnut-st., from the Chartiers railroad tracks to the bridge over Catfish creek.

St. Paul, Minn.—Bids will be asked for paving S. Wabasha-st. and Selby-ave. with asphalt as soon as the specifications for the latter are completed.

Summerville, Ga.—Ordinances have been adopted for improving Walton Way, including the laying of sidewalks, curbing, sewers, etc. Village com'rs.

West Washington, Pa.—The borough engineer has been instructed to make esti-

mates of the cost and ask for bids for 400 feet of paving on Chestnut-st.

Stroh, Ind.—The proprietor of the cement works in this city has offered to donate enough cement to build cement walks along both sides of the main street.

Charleston, Ill.—Ordinances have been passed providing for concrete walks on Adams, Fourteenth, Polk, Sixth, Buchanan, Seventh and Madison-sts. Mayor Ramsey.

Erie, Pa.—Ordinances have passed favorably for paving Twenty-first-st. from Peach to Sassafras. An ordinance has been introduced to repave French-st., from Eight to Eleventh.

Atchison, Kas.—Bids will be asked for paving, curbing and culverts on Atchison-st., from Fourth to Twelfth as soon as estimates have been prepared. Fred Giddings, cy. engr.

Manistee, Mich.—An ordinance has beene passed having in view the encouragement of constructing concrete walks by contributing out of the city treasury 5 cents per foot toward the cost of the walks.

Prophetstown, Ill.—Cement walks have been petitioned for by certain property-owners. The village board has decided to purchase another car load of paving brick for the construction of more street crossings this fall.

Three Rivers, Mich.—The mayor has been instructed to ascertain the cost of asphalt paving over the present cobblestone pavement on St. Joseph and Penn-sts. A sidewalk on Main-st. and a cross walk on Madison-st. is proposed.

Bay City, Mich.—An ordinance has been adopted for asphalt block paving on concrete base, with Medina stone curbing, on Van Buren-st., from Center-ave. to Ninth-st. Surveys have been made for sidewalks on a number of streets. Wm. Cunningham, mayor.

Syracuse, N. Y.—Plans have been approved for constructing flagstone or cement walks on both sides of Coleridge-ave., from Wilber to Whittier-ave. The city clerk has been authorized to ask for bids for paving Wellington-place, from Lemon-st. to Quincy-ave., with asphalt or brick.

St. Joseph, Mo.—Brick paving is proposed for Garfield-ave., from Eleventh to Sixteenth-st., and for Middleton, Isidore and Twenty-third-sts. An ordinance was passed Sept. 13 for paving King Hill-ave., from Sixth-st. to Illinois-ave., with brick and for constructing sidewalks in a number of streets.

Greenville, O.—Resolutions have been passed for constructing cement walks on both sides of Chestnut-st., from W. Main to W. Third-st., and for grading, graveling, setting curbs, gutters, etc., on N. Broadway, from the Dayton & Union Ry. to the North City limits. David Harter, prest. cy. coun.; E. E. Calderwood, cy. clk.

CONTRACTS TO BE LET.

Marquette, Mich.—Bids are asked until Oct. 1 for brick paving.

Gallipolis, O.—Sealed bids are asked until Oct. 1 for brick paving on Second and Olive-sts. George F. Bovie, cy. clk.

Greensburg, Ind.—Bids are asked until Oct. 4 for constructing brick sidewalks on First-st. W. R. Brazleton, cy. clk.

Cleveland, O.—Sealed bids are asked until Oct. 2 for brick paving on Wade Park-ave. Charles P. Salem, dir. pub. works.

Roseburg, Or.—Bids are asked until Nov. 4 for grading and improving with crushed rock on certain streets. D. S. West, cy. recorder.

Sullivan, Ind.—Sealed bids are asked until Oct. 14 for constructing 27,856 feet of free gravel roads in Curry twp. J. M. Lang, co. audt.

Yazoo City, Miss.—The contract for graveling the road from Joneston to the iron bridge will be let at public outcry Oct. 7. S. S. Griffin, clk. bd. supvrs.

Michigan City, Ind.—Sealed bids are asked until Oct. 14 for macadamizing E. Seventh-st., 4,400 sq. yds. of brick paving on Baker-ave. H. M. Miles, cy. engr.

Denver, Col.—Bids are asked until Oct. 9 for improving 7,700 ft. of roadway and a gateway at Ft. D. A. Russell, Wyo. Maj. J. W. Pope, ch. Q. M. U. S. A.

Rochester, Pa.—Sealed bids are asked until 7 p. m., Oct. 7, for grading and paving Madison-st., from the Big Beaver bridge to Brighton-st. J. P. Leaf, boro. engr.

Hammond, Ind.—Sealed bids are asked until 8 p. m., Oct. 1, for paving with macadam Fayette-st., from Hohman-st. to Calumet-ave. Peter J. Lyons, cy. engr.

Crawfordsville, Ind.—Sealed bids are asked until 4 p. m., Oct. 7, for grading and graveling Jefferson-st., from Oak-st. to Vandalia R. R. James A. McClure, cy. clk.

Perth Amboy, N. J.—Sealed bids are asked until 8:30 p. m., Oct. 7, for working the sidewalks of Woodbridge road from New Brunswick to Hall-ave. Matthew Weirup, st. comr.

Knox, Ind.—Sealed bids are asked until Oct. 7 for macadamizing and paving with stone four roads, aggregating 13 mls. Christian Borchardt, chmn. comrs. John W. Kurtz, co. audt.

Toledo, O.—Sealed bids are asked until Oct. 14 for paving with vitrified brick or block, or asphalt block, portions of Kent, Walnut, Jerome and Page-sts. J. E. Connell cy. clk.

Cleveland, O.—Sealed bids are asked until 12 m., Oct. 16, for brick and asphalt paving on concrete base, curbing, etc., on Detroit-st., from Highland-ave. to the Rocky river bridge in Lakewood hamlet. Julius C. Dorn, clk. co. comrs.

Logansport, Ind.—Sealed bids are asked until 5 p. m., Oct. 2, for cement walks on both sides of Burlington-ave. Sealed bids are asked until 5 p. m., Oct. 6, for graveling, curbing and guttering N. Fifth-st., from Linden-ave. to Miami-st. A. D. Fansler, cy. clk

Barberton, O.—Sealed bids are asked until Oct. 14 for brick paving as follows: Tuscarawas-st., brick paving, 11,560 sq. yds.; exca., 2,300 cu. yds.; curbing set and dressed, 4,634 lin. ft.; rough, 600 lin. ft. Second-st., brick paving, 9,605 sq. yds.; exca., 3,000 cu. yds.; curbing set and dressed, 4,310 lin. ft.; rough, 500 lin. ft. H. W. Alcorn, cy. engr.

CONTRACTS AWARDED.

Rockford, Ill.—John Rydblom secured the contract for macadamizing Forest-ave.

Milan, Mo.—The contract for macadamiz-

ing the public square was awarded to A. M. Veatch.

Suisun, Cal.—A. Steiger was awarded the contract for macadamizing road No. 79, for $3,200.

Madison, Wis.—The contract for macadam paving on Murray-st. was awarded to N. Quinn, for $3,596.

Milledgeville, Ill.—The contract for constructing 12,000 sq. ft. of cement walks was awrded to Peter O'Hair.

Newark, N. J.—The Newark Paving Company was awarded the contract for paving Verona-ave. with brick at $2.10 a sq. yd.

Ottumwa, Ia.—Jacob Kelm & Son secured the contract for constructing new walks, relaying old walks, foot crossings, etc.

Toledo, O.—The contract for constructing a stone road on Dorr-st. was awarded to C. W. Ryan at $17.50 a rod.

Cleveland, O.—The contract for macadamizing Noble road was awarded, Sept. 18, to Thos. H. Garland & Sons, for about $44,000.

Houston, Tex.—Hipp & Key have been awarded the contracts for paving on Franklin-st. and Preston and Leland-aves.

Seattle, Wash.—Stirratt & Goetz secured the contract for macadamizing Madison-st., from Broadway to Twenty-third-ave., for $28,823.

Findlay, O.—The contract for paving Second-st., from Main-st. to Washington-ave., with brick was awarded to C. B. Metcalf for $6,132.

Lafayette, Ind.—N. B. Moore was awarded the contract for improving Harvey-ave., from Grant-st. to Northwestern-ave., in West Lafayette.

Wilmington, S. C.—The contract for paving Princess-st. with brick was awarded to the Coal, Cement and Supply Company for about $3,000.

Quincy, Ill.—The contract for constructing a macadam road 3,162 ft. long in the new manufacturing district was awarded to Henry Rees.

Columbus, O.—John P. Crowe and Wm. Kees were awarded the contract for improving Leonard-ave., from Denmead to Galloway-ave. for $1,226.

Great Falls, Mont.—The contract for boulevarding Fifth-st., N., from Park Drive to Twelfth-st., was awarded to L. J. Cresswell for $6,545.80.

Jeffersonville, Ind.—The contract for reconstructing Spring-st., from Court to Eighth, was awarded to Falls City Art. Stone Company at $2.67 a sq. yd.

Kenosha, Wis.—The contract for paving Milwaukee-ave. with brick was awarded to A. E. Rutledge of Rockville, Ill., for $32,813.90. Purington brick will be used.

Muskegon, Mich.—Lutton & Reynolds of Grand Rapids secured contracts for paving two streets with brick for $14,633; John Hughes, Lake-st., $33,433; W. R. Jones, Pine-st., $12,839.

Racine, Wis.—The contract for macadamizing Villa-st., from Sixth to Seventh, was awarded to Harding & Nelson at 85 cts. a sq. yd. and 47 cts. a lin. ft. for combined curb and gutter.

Vailsburg, N. J.—The contract for constructing artificial stone walks was awarded to Wm. H. Turrell for $5.569, and for curbing, guttering and grading in four streets to Frank W. Snyder for $4,732.

The contract for 35,260 sq. yds. of brick paving in Fourth ward was awarded to E. A. Wickham at $17.45 a sq. yd., using Galesburg brick for the top and Council Bluffs brick for the bottom course.

Meadville, Pa.—The contracts for paving Market and Walunt-sts. with brick were awarded, Sept. 20, as follows: Market-st., Mack brick, Jas. McAfee & Co.; Walnut-st., Jamestown repressed brick, Fred'k Robinson & Co.

Peoria, Ill.—Thompson & Case submitted the lowest bid, Sept. 17, for brick paving on Bradley-ave., from Bourland-st. to Institute-place, and University-st., from Barker to Bradley-ave. at $1.02 a sq. yd. and will probably be awarded the contracts.

Albany, N. Y.—Bids were received Sept. 16 for paving Broadway in front of the Union station, with asphalt, as follows: Metropolitan Asphalt Company, $2.19 a sq. yd.; Warner & Quinlan, $2.90. Bids were also received for paving Perry-st. and Livingston-ave. with brick.

San Francisco, Cal.—The contract for basalt block paving on Sacramento-st., from Gough to Octavia, was awarded to Williams, Belser & Co. as follows: Stone curbing, $1.12 a lin. ft.; basalt block guttering, 58 cts. a lin. ft.; basalt block paving, 19 cts. a sq. ft.

Buffalo, N. Y.—The lowest bids received Sept. 11 for repaving Ryan, East and Hamilton-sts. with asphalt and brick were as follows: Henry P. Burgard, asphalt, East-st., $13,700; Hamilton-st., $4,800; Ryan-st., $13.700. L. H. Gipp, brick, East-st., $17,500; Hamilton-st., $6,400; Ryan-st., $10,400.

Springfield, O.—Paving contracts were awarded Sept. 10 as follows: Williams Bros., Campbell, State to Grand, 50 cts. per front ft.; Grant, Walnut to North, 63½ cts.; Grant, College to Walnut, 43 cts.; Grant, Vernon to State, 34 cts. W. M. Brown—Jefferson-st., Louis to Madison, 25 cts.

Elizabeth, N. J.—Bids have been received for trap block paving in Chestnut-st. as follows: D. M. Shanley, jr., $10,600; James J. Potts, $11,553. The property-owners protested against trap rock and asked for asphalt, with the result that the matter was referred to the committee on streets and parks.

Toronto, Ont.—The contract for paving a portion of Euclid-ave. with asphalt has been awarded, according to press reports, to the Barber Asphalt Paving Company for $14,000. The Dominion Paving and Construction Company secured the contracts for macadamizing Smith and De Grassi-sts. for $3,699 and $4,624 respectively.

Cohoes, N. Y.—The contract for paving Schuyler-st., from Remsen to Congress, was awarded Sept. 14 to the New York and Bermudez Company of New York. From Rensen-st. to Main the street will be paved with Mack brick at $2.53 a sq. yd. and from Main to Congress with asphalt at prices ranging from $1.84 to $2.11 a sq. yd.

Freeport, Ill.—Bids were received Sept. 17 for paving Stephenson-st. as follows: G. Maffioli of Rockford—Brick paving, $22,673.70; grading, $1,812.50; concrete under tracks, $2,000. J. Stewart, city—Brick paving, $25,552.90; grading, $1,631.25; concrete under tracks, $1,720. Action on the bids was deferred.

Milwaukee, Wis.—Contracts for furnish-

ing materials have been awarded as follows: Gravel—Rudolph Gumz, Twenty-third ward, 62 cts. a yard; F. C. Vogt, Thirteenth ward, 73 cts. Crushed stone—Louis Manegold, Nineteenth ward, $1.05 a yd.; C. Beck, Seventeenth ward, $1.30; J. W. Bingham, Eleventh ward, $1.23; F. C. Vogt, Twelfth ward, $1.17; W. E. Story, Twenty-third ward, $1.17.

Streator, Ill.—Brick paving contracts have been awarded as follows: Kent-st., from Park to Bloomington, single course brick, George Schwartz, $1.08, and from Bloomington to Sherman, $1.06½ a sq. yd.; Lincoln-ave., from Adams to Glass, single course, John Baer, $1.10 a sq. yd.; S. Everett, from Main to Wilson, double course, Sam Smith, $1.33 a sq. yd.

Birmingham, Ala.—The street committee will recommend the award of contracts as follows: Twenty-first-st., brick paving, Southern Paving and Construction Company of Chattanooga, Tenn., $29,533; Macadamizing and curbing certain streets, Dunn & Lallande Bros., city, $7,142; artificial stone walks, Stamsen & Blome of Chicago, $16,028, and H. E. Manville & Co., $11,986 and $20-211; macadamizing and curbing, C. M. Burkhalter & Co., $8,907.

Astabula, O.—The contract for paving High-st., 2,388 sq. yds., was awarded to E. G. Pulman and H. Strakweather of this city as follows: Excavation, 770 cu. yds. at 30 cts.; furnishing and laying 6-in. concrete at 85 cts. per sq. yd.; 1½-in. sand cushion at 3 cts.; Metropolitan block at 76 cts.; laying and filling with sand at 20 cts.; total, $5,672.

Indianapolis, Ind.—Contracts were awarded Sept. 16 as follows: Adelaide-st., brick, Capital Paving and Construction Company, $1.28 a lin. ft.; an alley, brick, W. K. Copper & Co., $1.21; Arrow-ave., cement walks, Rogers & Dunlap, $1.29¾ a lin. ft.; Pennsylvania-st., from Maryland to Georgia sts., cement walks, A. D. Bowen, $1.95 a lin. ft.; Washington-st., from California to Blac - ford-st., cement walks, $2.43; cement walks in large number of sts., Henry Maag, 62 cts. to $1.24 a lin. ft.

Kansas City, Mo.—Paving contracts were awarded Sept. 13 as follows: Repairing asphalt in Independence-ave., Fourteenth, Olive and Prospect-sts., Barber Asphalt Paving Company, $1.50 a sq. yd.; asphalt paving on Eleventh-ave. from Agnes to Indiana-st., Barber Asphalt Paving Company, $2.12; asphalt paving on Penn-st., from Thirty-first to Thirty-third-st., Parker-Washington Company, $2.15 a sq. yd. or $7,948.55; curbing Chestnut-st., $570.60 and Thirty-first-st., $777.96, Sutherland Stone Company.

White Plains, N. Y.—Paving contracts have been awarded as follows: To Bellew & Merritt, Westchester-ave., $18,153.54; North-st., $12,309.20; Lake-st., $3,138.60; Orawaupum-st., $49,052.60; Battle-ave., $4,558; Tarrytown road, $2,227.05. To Erbeck Bros., William-st., $9,958.54; Cottage-place, $2,-845.96; Martine-ave., $19,451.55; Brookfield-st., $14,460.80.

Erie, Pa.—The contract for repaving State-st. with asphalt, from Eighth to Second, 12,500 sq. yds., was awarded Sept. 16 to the Cleveland Trinidad Asphalt Company at $1.69 a sq. yd.; 80 cts. a lin. ft. for Medina stone curbing; 60 cts. for sandstone curbing; $25.00 for catch basins; $5.00 for landmarks protected; 61 cts. a lin. ft. for 12-in. pipe, 50 cts. for 9-in. and 40 cts. for 6-in. Bids were received Sept. 20 for repaving Peach-st., from Twelfth to Twenty-sixth, but they were rejected as too high.

Detroit, Mich.—The franchise for constructing a subway along the river front has been granted to Marcus Pollasky. Contracts were awarded Sept. 8, to the American Contracting Company, for paving Cass-st. with asphalt at $1.80 and Randolph-st. at $1.97 a sq. yd. The lowest bids received Sept. 11 for paving five streets were as follows: Henchie-ave., James Grant, $1.61 with Medina curb and $1.57 with Berea curb; Field-ave., Archie Grant, $1.68 with Medina curb; John McLaughlin, $1.64 with Berea curb; Brooklyn-ave., J. A. Mercier, $1.72 Medina curb; H. Merdian Company, $3,308.02 Berea curb; Claremont-ave., J. A. Mercier, $1.65 Medina curb and $1.61 Berea curb; Champlain-st., Jas. Hanley, $1.74 Medina curb and $1.69 Berea curb.

SEWERS.

Brooklyn, N. Y.—The construction of the big Tenth-ave. sewer has begun. It will require two and one-half years to complete it.

Sea Isle City, N. J.—The city council revoked the franchise of the Sea Isle City Sewer Co. The company had failed to live up to the terms of the ordinance under which the contract was granted.

Washington, D. C.—The district commissioners have refused to grant an extension of time to the Camden Iron Works of Philadelphia for delivering the 24-inch centrifugal pump, with engine, boiler, etc., for the sewage pumping station in this city. The contract calls for the delivery and installation of the machinery by Jan. 1, 1903.

CONTEMPLATED WORK.

South Portland, Me.—An issue of $10,00 sewer bonds has been authorized.

Charlotte, Mich.—The issue of bonds for a sewerage system is proposed.

Bloomington, Ill.—A sewer in E. Jefferson-st. is contemplated.

Ashland, O.—Plans for a sewerage system have been submitted.

Atlantic, Ia.—A tax levy has been provided for building a sewerage system.

Peoria, Ill.—Plans are being prepared for the East Bluff sewer system.

Goshen, Ind.—A sewer in Third-st., from Washington to Pearl-st., is contemplated.

Rochester, Pa.—Petitions for sewers on Jefferson and Shields-sts. are being considered.

St. Johnsville, N. Y.—The question of a sewerage system is being agitated.

Madison, Wis.—Plans for new sewers have been prepared. F. E. Turneaure, cy. engr.

Dayton, Wash.—An ordinance has been passed to construct sewers in certain streets.

Gladwin, Mich.—A trunk sewer in Cedar-ave. is contemplated. Floyd E. Armstrong, clk.

East Hartford, Conn.—Bids will be asked soon for a sewer in Rector and Bigelow-sts.

Lancaster, O.—This city is considering a proposition of the American Construction

Company to construct a sewerage system. A rental is to be charged for connections and the city will have the privilege of buying the plant at the end of ten years.

Thief River Falls, Minn.—The question of building a sewerage system will be voted on this fall.

Sunbury, Pa.—The town will be surveyed for storm water drainage by W. H. Dechant of Reading.

Roswell, N. M.—This town voted Sept. 17 to issue $35,000 for a sewerage system.

Parkersburg, W. Va.—Petitions have been received asking for sewers in the Fifth ward and Latrobe-st.

Cloquet, Minn.—Plans for a sewerage and water works system have been made. The estimated cost is $57,209.

Lewiston, Mont.—The question of issuing bonds for a sewerage and water system will be voted on Nov. 8.

Burlington, Ia.—Resolutions have been introduced providing for sewers in certain streets. Mayor Marquadt.

Wellesley, Mass.—Preliminary surveys for a sewerage system will be made by F. L. Fuller, C. E., Boston.

Greenville, Miss.—This city voted Sept. 16 to issue $50,000 bonds to complete the sewerage system.

Monmouth, Ill.—An ordinance has been passed to extend the northeast sewer at an estimated cost of $4,315.95.

Topeka, Kas.—Plans and estimates for a 3-ft. brick storm water sewer will be submitted Oct. 6 by Engr. McCabe.

Hancock, Mich.—City Engr. Stockley has been authorized to prepare plans and specifications for a sewer.

Perth Amboy, N. J.—An ordinance has been approved for a brick sewer in State-st. John F. Rielley, cy. clk.

Binghamton, N. Y.—Resolutions were passed Sept. 17 providing for sewers in a number of streets. Cy. Engr. Monroe.

Lambertville, N. J.—The question of going ahead with the proposed sewer construction is being considered by the council.

Washington, Pa.—The borough engineer has been directed to ascertain the cost of a sewer on College-st., from South to Maiden.

Marshall, Mich.—Estimates for a sewer in Mansion-st. have been prepared and will be considered Oct. 7. Cy. Surv. Sawyer.

Perth Amboy, N. J.—A resolution has been adopted to construct brick sewer in New Brunswick-ave. John F. Rielly, cy. clk.

Los Angeles, Cal.—The question of issuing $726,000 bonds for the extension of the sewerage system will be voted on in October.

Winchester, Mass.—The estimated cost of draining the Church-st. district is $10,000, and for laying a new siphon under the river $4,000.

Dixon, Ill.—Ordinances have been passed for sewers with manholes on Crawford and N. Demont-aves. E. W. Smith, cy. clk.; F. A. Truman, mayor.

Albany, N. Y.—Plans for an intercepting sewer along Quay-st., from Water-st. to the Colombia-st. pier bridge are being prepared by the Central Hudson engineers.

White Plains, N. Y.—The village engineer has been directed to prepare plans and estimates for a storm water drain to the Bronx river, and for a sewer in Old Spring-st.

Syracuse, N. Y.—The council unanimously voted, Sept. 23, to construct the intercepting sewer along the east side of Onondaga creek, from Hiawatha-ave. to Midland-ave. Mayor Maguire.

Hartford City, Ind.—This city will probably readvertise for bids for building a sewer. W. B. Stitt of Wabash, who had the contract, has asked the city to release him from it.

Geneva, O.—An ordinance was adopted, Sept. 23, authorizing the wells and water committee to procure the services of an engineer to make blue prints and estimates for a sewerage system.

CONTRACTS TO BE LET.

Columbia, Mo.—Bids are asked until Oct. 1 for building sewers in dist. No. 6. John S. Bicknell, cy. clk.

Monticello, Ind.—Sealed bids are asked until 7 p. m., Oct. 5 for a sewer. W. J. Gridley, town clk.

Anaconda, Mont.—Bids are asked until 12 m., Oct. 7 for a sewer through certain alleys. G. S. E. Wisner, cy. clk.

Wausau, Wis.—Bids are asked until Oct. 7 for sewers in Warren and Seventh-sts. John R. Patzer, cy. clk.

Elkhart, Ind.—Bids are asked until Oct. 2 for a sewer in Oakland-ave. and W. Franklin-st. L. E. Hitchcock, cy. engr.

Bedford, Ind.—Bids are asked until Oct. 1 for a sewerage system and disposal plant. G. C. Houston, cy. engr.

Michigan City, Ind.—Sealed bids are asked until 5 p. m., Oct. 14 for a main sewer in an alley. E. J. Heise, cy. clk.

Lakewood, O.—Bids are asked until Oct. 5 for part of section 3 of the general sewer system. John French, hamlet clk.

Greenwood, Miss.—Bids are asked until 8 p. m., Nov. 1 for constructing a sewerage and water works system. C. E. Wright, prest.

St. Cloud, Minn.—Bids are asked until 8 p. m., Oct. 7 for a lateral sewer on Second-st. from Seventh to Eighth-ave. H. J. Limperich, cy. clk.

Conneaut, O.—Sealed bids are asked until 12 m., Oct. 8 for 4-mis. of sewers in dists. No. 3 and 4. W. F. Stanley, mayor; George B. Pike, cy. engr.

Washington, D. C.—Sealed bids are asked until 12 m., Oct. 5 for sewers in the District of Columbia. H. B. F. McFarland, chrm. dist. comrs.

Hammond, Ind.—Sealed bids are asked until 3 p. m., Oct. 1 for building sewers in Alice, Thornton and Walter-sts. Peter J. Lyons, cy. engr.

Kankakee, Ill.—Bids are asked until Oct. 1 for constructing 7,700 ft. of rock and 18 to 30-in. pipe sewer. Robert D. Gregg, cy. engr.

Plainfield, N. J.—Bids are asked until Oct. 7 for constructing an addition to the present sewerage system. George B. Wean, cy. clk., pro tem.

Cleveland, O.—Sealed bids are asked until 12 m., Oct. 8 for a sewer in Taylor-st., between Franklin-ave. and Lorain-st. Charles P. Salen, dir. pub. wks.

Barberton, O.—Sealed bids are asked until Oct. 14 for 11,655 ft. storm sewers, 29 manholes, 81 catch basins and 4 lamp holes. H. W. Alcorn, cy. engr.

Thomaston, Me.—Bids are asked until

Oct. 2 for a new sewer from the state prison to the George river, 500 ft. Philip H. Coombs, Bangor, Me., engr.

Logansport, Ind.—Bids are asked until Oct. 16 for sewer extensions as follows: 1,220 ft. of 12-in., 207 ft. of 10-in. and 700 ft. of 8-in. pipe. Walter A. Osmer, cy. engr.

Havana, Cuba.—Sealed bids are asked until 12 m., Oct. 23 (extended from Sept. 25) for a sewerage system and paving. Lieut. W. J. Barden, corps of engrs.; Miguel Geuer, mayor.

Boston, Mass.—Sealed bids are asked until 2:30 p. m., Oct. 8 for building part of section 75 of the high level sewer, in Roxbury. Henry H. Sprague, chrmn. Met. Water and Sewerage bd.

Meadville, Pa.—Sealed bids are asked until 4 p. m., Oct. 4 for a sewer on Green-st. as follows: 188 lin. ft. 8-in. and 120 lin. ft. 6-in. sewer; 8 6x8-in. Y's; 1 standard manhole. A. C. Pardee, cy. clk.

Xenia, O.—Sealed bids are asked until 12 m., Oct. 17 for lateral sewers in dist. No. 1 or Central dist. with sewer pipe, catchbasins, manholes, flush tanks, etc. H. E. Schmidt, prest. bd. sewer comrs.; C. W. Linkhart, mayor.

Santiago, Cuba—Sealed bids are asked until 2 p. m., Oct. 21 for constructing 52,000 ft. of vitrified pipe sewers; 1,730 ft. 23-in. double ring brick; 2,400 ft. 24 and 42-in. force main; Y branches; 89 single and 15 double flush tanks; 36,000 ft. 4 and 6-in. house connections, etc. S. D. Rockenbach, Capt. Twelfth U. S. Cavalry, engineer officer.

CONTRACTS AWARDED.

Rockford, Ill.—G. Maffiolo was awarded the contract for a sewer on N. Fourth-st. for $617.

Woodlynne, N. J.—The contract for a sewerage system was awarded to Geo. S. Allen of Trenton, N. J.

Cedar Falls, Ia.—The contract for a sewer in Tremont-st. was awarded to Warttman Bros. for $2,148.

Coldwater, Mich.—McKinney & Son of Toledo secured the contract for two new sewers for $6,035.

Paris, Ky.—G. O. Tenney of South Carolina, was awarded the contracts for building sewers for $22,711.

Dayton, O.—The contract for sewers in districts 4 and 5 was awarded to the Gem City Construction Company for $14,041.

Michigan City, Ind.—The contract for constructing sewers were awarded to J. Renkawitz & Co., for $2,650.

Oshkosh, Wis.—The contract for a sewer in Murdock-st. was awarded to Louis Larsen & Co. for about $12,000.

Ligonier, Ind.—The contract for a new sewer in the western part of the city has been awarded to Harry Spurgeon.

Helena, Mont.—Nels Wooder was awarded the contract for building a sewer on Twelfth-ave. and Raleigh-st. for $896.

Birmingham, Ala.—Dunn & Lallande of this city were awarded the contracts for sewers under ordinances 88 and 97 for $3,923.

Erie, Pa.—The contract for building a sewer in Myrtle-st., from Twenty-second to Twenty-third-sts., was awarded to Dennis O'Brien.

Milwaukee, Wis.—John H. Donahue was awarded the contract for section No. 4 of the west side intercepting sewer at $6.12 a lin. ft. F. H. Nakielski secured contracts as follows: Third-ave. and Bottom-st., 2,387 ft. of brick sewer, $16,112.25, and 850 ft. of pipe, $1,180; 1,364 ft. of brick and 120 ft. of pipe sewer on Greenbush-st., $4,272.

Cook's Mills, Ill.—The contract for laying 2 mis. of tile was awarded to J. F. Miller for $4,406. Robt. Morgan, town clk.

Great Falls, Mont.—The contract for a 9-in. lateral sewer in an alley was awarded to Thos. H. Hinds of Butte, Mont., for $1,626.16.

Colorado Springs, Col.—The contract for a new sewer in an alley between Jefferson and Monroe-sts., was awarded to Davis & Co.

Syracuse, N. Y.—C. F. Hookaway was awarded the contract for a 15-in. pipe sewer in Renwick-ave., from Adams to Jackson, for $1,171.50.

Fowler, Ind.—Wm. Frey of Lafayette, Ind., was awarded the contract for a sewerage system in this city for $8,494.61.

Fergus Falls, Minn—John Smith was awarded the contract for a sewer in Union-ave., from Alcott-st. to Vernon-ave., for $665.

Paw Paw, Mich.—The contract for a new sewerage system has been awarded to Geo. Rickman & Sons of Kalamazoo for $6,447.

Luverne, Minn.—The contract for building sewers on Estey and Cedar-sts. was awarded Sept. 17 to A. L. Jones of Canton, S. D., for $2,671.62.

Raton, N. M.—The contract for a sewerage system was awarded to the J. M. O'Rourke Construction Company of Denver, Col., for $20,000.

St. Paul, Minn.—The contract for a sewer on Van Buren-st., from Arundel-st. to Como-ave., was awarded Sept. 16 to W. J. Preston for $3,480.

Alexandria, Va.—The contract for a pipe sewer in King-st., from Fairfax-st. to the Potomac river, was awarded to S. P. Fisher for $1,109.

Joliet, Ill.—Monahan Bros. secured sewer contracts Sept. 11 as follows: D'Avery-ave. and Illinois-st., $1,543.20; Hunter-ave., $1,947.20; Washington-st., $1,175.10.

Crookston, Minn.—M. W. Barnard of Moorehead was awarded the contract for building a joint ditch between Norman and Polk counties, near Fertile, at 13 cts, a cu. yd.

Haddonfield, N. J.—The contract for a sewerage system and sewage disposal system was awarded to John Quinlan of South Amboy for $30,689.

Hartford, Conn.—The contract for building an intercepting sewer from the foot of Ward-place, along the Park river to Cemetery brook, was awarded Sept. 11 to Michael O'Neil for $7,905.50.

WATER-WORKS.

Ottumwa, Ia.—The contract for municipal water works was ratified by a vote Sept. 7.

Los Angeles, Cal.—This city voted in favor of issuing $2,000,000 bonds for the purchase of the existing water works.

CONTEMPLATED WORK.

Jamestown, N. Y.—A new water works plant will be constructed, the old one hav-

ing become inadequate, according to press reports.

Fort Morgan, Col.—The question of a reservoir is being considered.

Paulding, O.—Plans for a water works system have been prepared.

Nassau, N. Y.—Surveys are being made for an available water supply.

Bloomfield, Ia.—Bonds were voted for extending the water works.

Carthage, N. Y.—This city voted in favor of a new water supply.

Kansas City, Mo.—The purchase of 20,000 feet of iron water mains is proposed.

Spring Valley, Ill.—An extension of the water works service is contemplated.

Emporia, Kas.—An additional water works system will be constructed.

Bloomington, Ill.—Water mains will be laid in Phoenix-ave. and E. Jefferson-st.

Marshfield, Wis.—A series of driven wells will be sunk to increase the water supply.

La Crosse, Wis.—A settling tank in connection with the water works is proposed.

Amherst, Va.—The directors of the Sweet Briar Institute contemplate building water works.

Mantua, O.—Plans for a water works system are being made by L. E. Chapin of Canton, O.

Ft. Plain, N. Y.—Surveys are being made preliminary to the extension of the water works.

Deer River, Minn.—Plans for a water works system are being made by Thos. McGilvray of Duluth.

Duluth, Minn.—The water system will be extended about 26,167 feet at a cost of $26,394.

Marrillan, Wis.—Plans for a water works system are being made. Geo. K. Whitney, prest.

Rushville, Ill.—This city voted to appropriate $4,000 for sinking a deep well for a water supply.

Groton, Mass.—The Groton W. W. Co. voted to proceed at once with the construction of water works.

Atchison, Kas.—The Atchison Water Company contemplates enlarging its works. E. S. Wills, supt.

Southington, Conn.—A new filter dam at the reservoir is proposed by the Southington Water Company.

Winthrop, Minn.—Plans for the proposed water works and electric light plant have been prepared.

Dowagiac, Mich.—The purchase of a 3,000,000 gal. pump has been recommended by the board of public works.

Grand Rapids, Mich.—Plans for extending the intake up the river above the Soldiers' Home are being made.

East Orange, N. J.—The city engineer has been directed to advertise for bids for a supply of potable water.

Marshall, Mo.—Plans for a water works and electric light system are being made. A. R. James, cy. clk.

Geneseo, Ill.—The city council has authorized the issue of $20,000 bonds for the construction of water works.

Columbus, O.—The engineering department is preparing plans for a new reservoir and for the conduit system.

Allegan, Mich.—This city voted to bond for $15,000 for a new pumping house and machinery for the water works system.

Cambridge, Wis.—Plans and specifications for a water works plant will be made by W. G. Kirchoffer, Baraboo, Wis.

Springfield, Ill.—A new solid concrete dam at the Sangamon river for providing water for the city is proposed.

Los Angeles, Cal.—The specifications for the new pumping plant to be installed at the East Side park have been filed.

Palma, Mass.—The fire district committee has voted to employ an engineer to estimate the cost of a new water works system.

Columbus Grove, O.—Plans for a municipal water works will be made by G. L. McKibbin of Van Wert. Charles Killen, vil. clk.

Sandy Hill, N. Y.—Plans for enlarging the village water supply have been prepared. J. J. Cunningham, chmn. water com.

Colorado Springs, Col.—The purchase of the Seven Lakes property for a reservoir site is recommended by the sub-committee.

Waterloo, Ia.—The Waterloo Water Company has issued $170,000 bonds for improving its water works system, including new machinery, pipe, etc.

Water works bonds have been favorably voted on at the following places: Bedford, Ia.; Jesup, Ia.; Bath, Pa.; Blackstone, Va.; Sydney, N. S.

Sacramento, Cal.—The question of filtration of the Sacramento river water or procuring water from wells east of the city will be voted on in November.

Moline, Ill.—The council favors the mechanical filter system and plans will be prepared by D. W. Mead of Chicago for a filter of 5,000,000 gallons a day capacity.

Pueblo, Colo.—The mayors of Salida, Canon City, Florence and this city are considering ways and means for preventing the pollution of the Arkansas river.

Gas City, Ind.—The water and light committee has been directed to prepare plans and specifications for the necessary additions to the water and light plant.

Virginia, Ill.—Aldermen Schaffer, Dooling and Tate have been appointed a committee to investigate and report on plans for securing a water supply for this city.

Moline, Ill.—The board of directors of the Business Men's Association has been authorized to inquire into the feasibility of using poplar pipes for artesian water.

St. Louis, Mo.—Allen Hazen of New York City, George Y. Wisner of Detroit and Benezette Williams of Chicago are investigating for a pure water supply.

The question of issuing bonds for water works will be voted on at the following places: Lewiston, Mont.; Charlotte, Mich.; Wagoner, Mo.; McRae, Ga.; La Harpe, Kan.

Pittsburg, Pa.—Ordinances have been introduced authorizing the extension and improvement of the water supply, including a filtration plant, the purchase of three pumping engines and two pulsometer steam pumps.

Mexico, Mex.—A potable water supply will be developed by a syndicate of New York capitalists. The water will be taken from the springs at Alamoloya and pumped in three stages to an elevation of 1,456 ft. and then will fall 1,214 ft. to the city. The total length of pipe and canals will be 84 miles.

The construction of water works systems

is contemplated at the following places: Hibbing, Minn.; Muscoda, Wis., Sloan, Ia.; Spanish Fork, Utah; Mooresville, N. C.; Dillon, Mont.; Chester, Pa.; Caldwell, Ind.; Kissinmee, Fla.; Maryville, Tenn.; Oxfordville, Wis.; Thorold, Ont.; Windsor, Mo.; Trenton, O.

Springfield, O.—J. D. Cook of Toledo has submitted three plans for an increased water supply, as follows: (1) An auxiliary natural infiltration plant, composed of a receiving well, assisted by pipes or by a system of multiple wells. (2) By a system of radiating pipes from the present well, running 2,000 or 3,000 feet, which would draw from territory not now touched. (3) Raise the bottom of the present infiltration gallery, or well, 1½ feet from where it now rests on hard pan and place the bottom on gravel, so as to allow water to enter it from the bottom.

CONTRACTS TO BE LET.

Greenwood, Miss.—Bids are asked until Nov. 1 for a water works system. C. E. Wright, prest.

Fresno, Cal.—Bids are asked until Oct. 27 for supplying this city with water works. J. B. Johnson, cy. clk.

Centralia, Ill.—Bids will be received Oct. 4 for the new reservoir. The other bids were rejected as too high.

Raymond, Minn.—Bids are asked until Oct. 12 for drilling a 6-in. tubular well. B. F. Barnes, vil. rec.

Washington, D. C.—Bids are asked until Oct. 8 for extending the water works system at the Menominee School, Wis. W. A. Jones, com'r. Indian affairs.

Yazoo City, Miss.—Bids are asked until Nov. 11 for franchises for water works, sewerage ,electric light and street railway systems. E. J. Pruesine, cy. clk.

Cleveland, O.—Sealed bids are asked until Oct. 2 for about 8,700 ft. of 2-in. black wrought iron pipe and malleable iron fittings. Chas. P. Salen, dir. pub. wks.

Washington. D. C.—Sealed bids are asked until Oct. 5 for 20 water gates of 30, 36, 42 and 48-ins. diameter, equipped with hydraulic operating cylinders. H. B. F. MacFarland, chm. dis. com'rs.

CONTRACTS AWARDED.

Auburn, N. Y.—The contract for a new pump house was awarded to D. W. Barnes & Son for $14,344.

Elliott, Ia.—The contract for a water works system was awarded to Fairbanks-Morse & Co. of Omaha.

Osceola, Ia.—A 25-yr. franchise for water works has been granted W. M. Peatman of Centerville, Ill.

Elmore, Minn.—The contract for extending the water mains was awarded to W. I. Gray Company of Minneapolis for $3,093.

Kankakee, Ill.—The contract for constructing a filter was awarded to the Norwood Engineering company of Florence, Mass., for $40,000.

Glenwood, Minn.—The contract for extending and improving the water system was awarded to the Allen Black Company of St. Paul for $11,379.

Moline, Ill.—The contract for extending water mains to Stewartsville was awarded to the Moline Heating and Construction Company for $14,999.

Williamsburg, Ia.—The contract for changing the water system from gravity to compressed air was awarded to J. L. White of Perry, Ill.

Rochester, N. Y.—Whitmore, Rauber & Vicinus secured the contract for extending the water mains in a large number of streets for $2,045.10.

West Minneapolis, Minn.—The contract for a water works system was awarded to the Challenge Feed Mill and Wind Mill Company of Batavia, Ill., for $14,780.

Kokomo, Ind.—The contract for building a municipal water works system was awarded to the Ft. Wayne Construction Company of Ft. Wayne, Ind., for $177,994.

BRIDGES.

Peoria, Ill.—A viaduct or subway at Sanger-st. is contemplated.

Beloit, Wis.—Bids will be asked for a new steel central bridge. B. P. W.

Philadelphia, Pa.—About $220,000 will be expended next year for new bridges.

Terre Haute, Ind.—The estimated cost of the proposed new bridge is about $175,000.

Auburn, Ind.—Sealed bids are asked until Oct. 9 for three steel bridges. F. P. Seiler.

Sandusky, O.—The question of building a new bridge over the Huron river will be voted on.

Topeka, Kas.—The question of building a bridge across the Kansas river will be voted on in November.

Liberty, Ind.—Bids are asked until Oct. 7 for building an iron bridge. Milton Maxwell, co. audt.

Iron City, Tenn.—Bids are asked until Oct. 5 for a steel highway bridge. F. M. Cannon, chmn, br. com.

Boonville, Ind.—Bids are asked until Oct. 7 for a steel bridge over Pigeon river. M. Folsom, co. audt.

Plymouth, Ind.—Bids are asked until Oct. 8 for bridge work in Tippecanoe township. Harry W. Miller, co. audt.

Lebanon, O.—Plans and specifications for a bridge across Sugar run, Harlan township, have been approved.

Batavia, N. Y.—Bids are being asked, according to press reports, for a steel girder bridge at Walnut-st.

Boise, Idaho—Plans and specifications have been prepared for a bridge across Boise river at Eagle Island.

Salinas, Cal.—Bids are asked until Oct. 8 for constructing a bridge across Peach Tree creek. J. D. Kaler, clk.

Roswell, N. M.—Bids are asked until Oct. 7 for building a steel bridge 3 miles east of this place. Co. com'rs.

Peabody, Mass.—This town voted to appropriate $25,000 for rebuilding the Endicott bridge over the Boston & Maine R. R.

Glens Falls, N. Y.—Bids are asked until Oct. 19 for replacing Glen's bridge. John D. Partridge, supt. pub. wks.

Ferndale, Pa.—The construction of a county bridge across Lehigh river is recommended; also a bridge in Blacklick twp.

Birmingham, Ala.—The board of revenue has been granted permission to build a bridge across Five-Mile creek at Cardeft.

Rochester, N. Y.—Plans are being made for a new bridge over the Erie canal at

Plymouth-ave. Edward A. Bond. state engr.

Laporte, Ind.—Sealed bids are asked until Oct. 22 for building a draw bridge over the harbor at Michigan City. F. H. Doran, co. audt.

Lancaster, Pa.—Bids are asked until Oct. 14 for a bridge over Little Beaver creek in the Borough of Quarryville. A. B. Hassler, co, cont.

Kankakee, Ill.—The question of building a bridge across the Iroquois river at Sugar island, between Otto and Aroma twps. has been favorably voted on.

Milwaukee, Wis.—Bids are asked until Nov. 1 for constructing a highway bridge across the Milwaukee river, from Broadway to Lake-st. John R. Wolf, compt.

Lawrenceburg, Tenn.—Bids are asked until Oct. 5 for building a three-span steel bridge across Shoal creek at Iron City. F. M. Carmon, clk. bridge com.

Lampasas, Tex.—The counties of Lampasas and San Saba voted in favor of building an iron bridge across Colorado river, connecting the two counties.

Mankato, Minn,—Bids are asked until Oct. 7 for the constructing of two stone arches, one across Plum creek and one across Disappointment creek. Co. com'rs.

Kansas City, Mo.—Plans for a steel plate girder bridge to be constructed at Benton boulevard, have been prepared by Geo. B. Kessler, engr, park, bd.

Iuka, Miss.—Bids will be received until Oct. 7 for building a bridge across Berea creek, four miles south of Brunsville. P. W. Patterson, clk. bd. supvrs.

Detroit, Mich.—Plans for a bridge to be constructed of Forest City sandstone and vitrified paving brick, to cross Lake Tacoma, have been prepared.

LaSalle, Ill.—A resolution has been adopted to appropriate $7,000 for raising and extending a highway bridge across the Big Vermillion river in Deer Park twp.

Mansfield, O.—A resolution has been adopted authorizing the city engineer to prepare plans for a viaduct either of steel or iron or block or stone, at S. Mulberry-st.

Canandaigua, N. Y.—A swing bridge over the canal is proposed by the board of trade.—Jas. Arkell and Willis Bullock have been appointed a committee to investigate the matter.

Wilkesbarre, Pa.—The street committee of the city council will order the construction of a larger and more substantial bridge to replace the present structure across the railways an South-st.

St. Petersburg, Russia.—Competitive plans will be received until Sept. 1, 1902, Russian calender (Sept. 14, our calender) for two bridges across Great Neva river. St. Petersburg Garodskaja Uprawa, St. Petersburg.

Milwaukee, Wis.—An ordinance has been introduced providing for a $250,000 bond issue for building a viaduct over the Menominee valley from Washington-ave., in the Sixteenth ward, to Washington-ave., in the Twenty-third ward.

Sydney, N. S. W.—Sealed bids are asked until Feb. 28, 1902, for the construction of a bridge over Sydney Harbor, embracing a main span of not less than 1,200 ft. in the clear, with sufficient approach spans to make up a total length of 3,000 ft. Secy, pub. wks. Percy Sanderson, British consul for New York, 17 State-st., New York City.

STREET LIGHTING.

Will vote: Terry, Mass.; Holley, Mich.

Voted for: Flora, Ill.; Harrisonburg, Va.; Washington, Ia.

Greenwood, Miss.—A electric franchise has been granted C. E. Wright.

Manson, Ia.—A franchise for an electric light plant has been granted G. E. Haney.

Fortville, Ind.—A twenty-five-year franchise has been granted I. N. Stabler of Fairmount.

Shenandoah, Ia.—The contract for street lighting was awarded to the Shenandoah Electric Light and Power Company.

Sarnia, Ont.—A thirty-year franchise for laying gas piping to Point Edward has been granted the Sarnia Gas and Electric Company.

Conneaut, O.—Bids are asked until Oct. 5 for an addition to the electric light plant. W. O. Hall, secy.

Altamont, Ill.—A contract for building an electric light plant has been awarded to T. C. Reed of Chicago for $12,875.

Saginaw, Mich.—The board of public works has been directed to prepare plans and specifications for an electric light plant.

Kansas City, Mo.—A contract for 100 lights was awarded to the Welsbach Street Lighting Company Sept. 17 at $2.50 a month.

Centerville, Ia.—The question of granting the franchises for an electric railway, heating plant will be voted on Oct. 3.

Wichita, Kas.—Mayor McLean vetoed, Sept. 17, the contract with the M. & M. Oxygen Company of Kansas City for vapor lights.

Topeka, Kas.—F. W. Roby of Amherst, N. H., will build an electric light plant in this city, at a cost of $100,000.

Brazil, Ind.—Bids are asked until Oct 1 for lighting this city with electricity for five or ten years. Jos. W. Williams, cy. clk.

Cleveland, O.—A contract for 5,000 new lamps for gas lighting purposes has been awarded to the Cleveland Vapor Lighting Company, at $16.10 per lamp.

Utica, N. Y.—A contract for lighting this city for five years has been awarded to the Utica Electric Light and Power Company at 30 cts. per light per night.

Manistee, Mich.—The contract for electric lighting has been awarded to Louis Sands for ten years for 105 street lamps at $70.00 per annum.

Thomaston, Ga.—Bids are asked until Oct. 1 for furnishing and erecting machinery for the electric light plant. Brown & Collier, Atlanta, Ga., engrs.

Contemplated: Newberry, Mich.—Pawnee, Mo.; Oxford, Md.; Jamaica, Vt.; Auburn, Neb.; Delmar, Del.; Hempstead, Tex.; Aguas Calientes, Mex.; Boonville, N. Y.; Mechanicsburg, O.; Mt. View, Cal.

DeKalb, Ill—A 10-year contract for street lighting was awarded to the DeKalb Electric Company as follows: 120 32 C. P. in-

candescent lights, 12 o'clock service, $14.50 per lamp per year; 40 1,200 C. P. arc lights, all night service, $72.50 per lamp per year.

St. Cloud, Minn.—The plant and franchise of the St. Cloud Gas and Electric Company was sold Sept. 12 by H. S. Abbott, special master in chancery of the federal court, to A. F. Howard and others of Portsmouth, N. H., for $84,864.04. To this must be added $38,500 in receiver's certificates, $1,300 interest, and about $5,000 for expense of sale.

PARKS.

Burlington, Vt.—The question of procuring land on the Lake Shore for a park is being considered by this city. Mayor Hawley.

Kansas City, Mo.—An ordinance is pending which provides for the establishment of a park in the Smith district.

Terre Haute, Ind.—A new park will be opened next summer on twelve acres of land adjoining the grounds of the old Ft. Harrison Hunting & Fishing Club grounds.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Columbia, S. C.—The common council has decided to build a crematory to consume dry garbage.

Lewiston, Idaho.—The contract for street sprinkling was awarded to Sprague & Crozier at $4 a day.

Milwaukee, Wis.—The board of public works will re-advertise for bids for sweeping the streets.

Trenton, N. J.—The street committee has been instructed to ask for bids for removing garbage for the ensuing year.

Topeka, Kas.—The proposition of Frank Zingheim to build a garbage crematory and dessicating works has been favorably reported.

Columbus, O.—The mayor and director of public improvements has been authorized to borrow $50,000 to be used for sprinkling, sweeping and cleaning the streets.

St. Louis, Mo.—A bill has passed the assembly authorizing the board of health to let a contract for the reduction of garbage. The contract will be for three years.

New Castle, Pa.—Bids were received Sept. 9 for the proposed new garbage furnace as follows: The Dixon Garbage Crematory Company, 25-ton double furnace, with iron stack, $5,000; with building, $8,800; 30-ton iron stack, double furnace, $6,000; with building, $10,300; 30-ton brick stack, double furnace, $7,100; with building, $11,400; 30-ton single furnace, with double brick stack, $7,100, with brick building, $11,400; 25-ton single furnace, with double brick stack, $6,300; with building, $10,100. The Bridgeport Boiler Company bid for a crib of 25-ton capacity Smith improved garbage furnace and crematory, with a stack 100 ft. high and 36 in. in diameter, $6,000; with building, $2,500 additional. With cribs so as to increase the capacity to 50 tons, $4,500 additional.

TOO LATE FOR CLASSIFICATION

Niles, Mich.—City council has decided to macadamize 11 blocks of Main-st.

Austin, Tex.—Action will be taken at once on the proposed paving of Congress-ave.

South Haven, Mich.—A cement walk has been petitioned for on the S. S. of Phoenix-st. A. Ryall, village clk.

Indianapolis, Ind.—Sealed bids are asked until 10 a. m. Oct. 2 for building a sewer. Albert Sahm, chm. B. P. W.

Hudson, Mich.—A resolution has been passed providing for the construction of an 18-in. sewer on Main-st. Fred P. George, cy. clk.

Cass City, Mich.—The city council has decided to have a complete survey made of this city preparatory to constructing a sewerage system.

Hoopeston, Ill.—The contract for paving First-ave. and S. Market-st. with brick was awarded to H. C. Finley, of this city, at $1.05 a sq. yd.

San Antonio, Tex.—Sealed bids are asked until 12 m. Oct. 4, for sinking two artesian wells at Fort Sam Houston. John L. Clem, D. Q. M. G., C. Q. M.

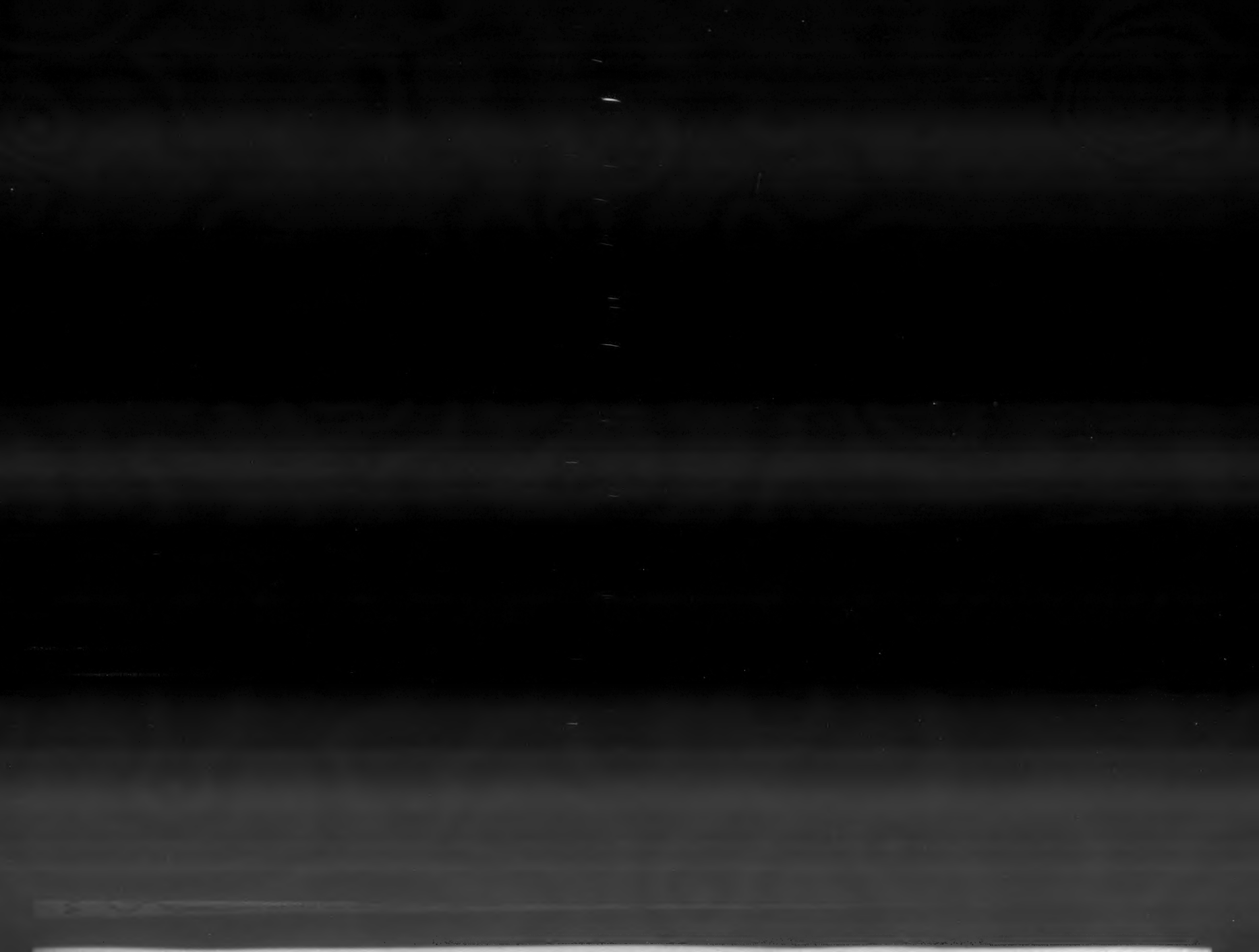
Manhattan,, Kan.—An ordinance was adopted, Sept. 17, providing for vitrified brick sidewalks on Leavenworth, Ninth and Moro-sts. H. W. Hungerford, cy. clk.

Delaware, O.—The contract for building a sewer has finally been awarded to Ulrick & Williams, of Springfield, O. A disposal plant will also be constructed.

Lewiston, Me.—Sealed bids are asked until 12 m. Oct. 2. for building a sewer and blasting a quantity of ledge rock on the property of the prison institution. Yoeman Smith, warden.

Webb City, Mo.—The Joplin Construction Co., of Joplin, Mo., was awarded the contract, Sept. 16, for district sewer No. 3, 2,760 ft., at 71½ cts. a ft. C. F. Schilling, of Joplin, secured district sewer No. 5, 520 ft., at $1.15 a ft.

Milwaukee, Wis.—Sealed bids will be received until 10:30 a. m. Oct. 2, for building brick and pipe sewers in Washington, Hayes and Forest Home-aves.; for constructing section No. 8 of the Thirtieth-st. tunnel; for paving the gutters and crosswalks on Chestnut-st., from Twelfth-st. to Washington-ave., with brick. Chas. J. Poetsch, chm. B. P. W.

Henderson, Ky.—John Hoffey was awarded contracts, Sept. 20, for improving Second-st., between Green and Elm, and First-st. between Green and Water. The Spottsville Iron and Gravel Co. was awarded contracts as follows: Furnishing 100 cu. yds.1-in. rock, $1.00 a cy. yd.; 1500 cu. yds. 2-in. rock, $1.33; 350 cu. yds. screenings, $1.05. An ordinance was passed providing that the question of a filter plant will be voted on in November.

Buffalo, N. Y.—Bids were received until Sept. 20 for paving Grace-st. as follows: German Rock Asphalt & Cement Co., asphalt,$11,490; American Contracting Co., asphalt, $13,900; Barber Asphalt Paving Co., asphalt, $11,716.50; Inter-State Paving Co., asphalt, $11,200; F. P. Burgard, asphalt, $10,700; brick, $11,700; Christ Knoblock, brick, $11,749; Louis H. Gipp, brick, $11,297; John Munn, brick, $11,949; Miller & Franklin, brick, $11,975.